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Engineering News-Record

March 31, 1921

Four Important Articles on Different Phases of Engineering and Contracting

Motor Truck Impact on Roads

Preliminary indications of the comprehensive series of tests upon which the U. S. Bureau of Public Roads has been at work for two years.

Contractor's Rights in a Municipal Contract

Important decision just rendered in the case of the clearwater basin at Cleveland, Ohio laying down basic principles in contractural relation.

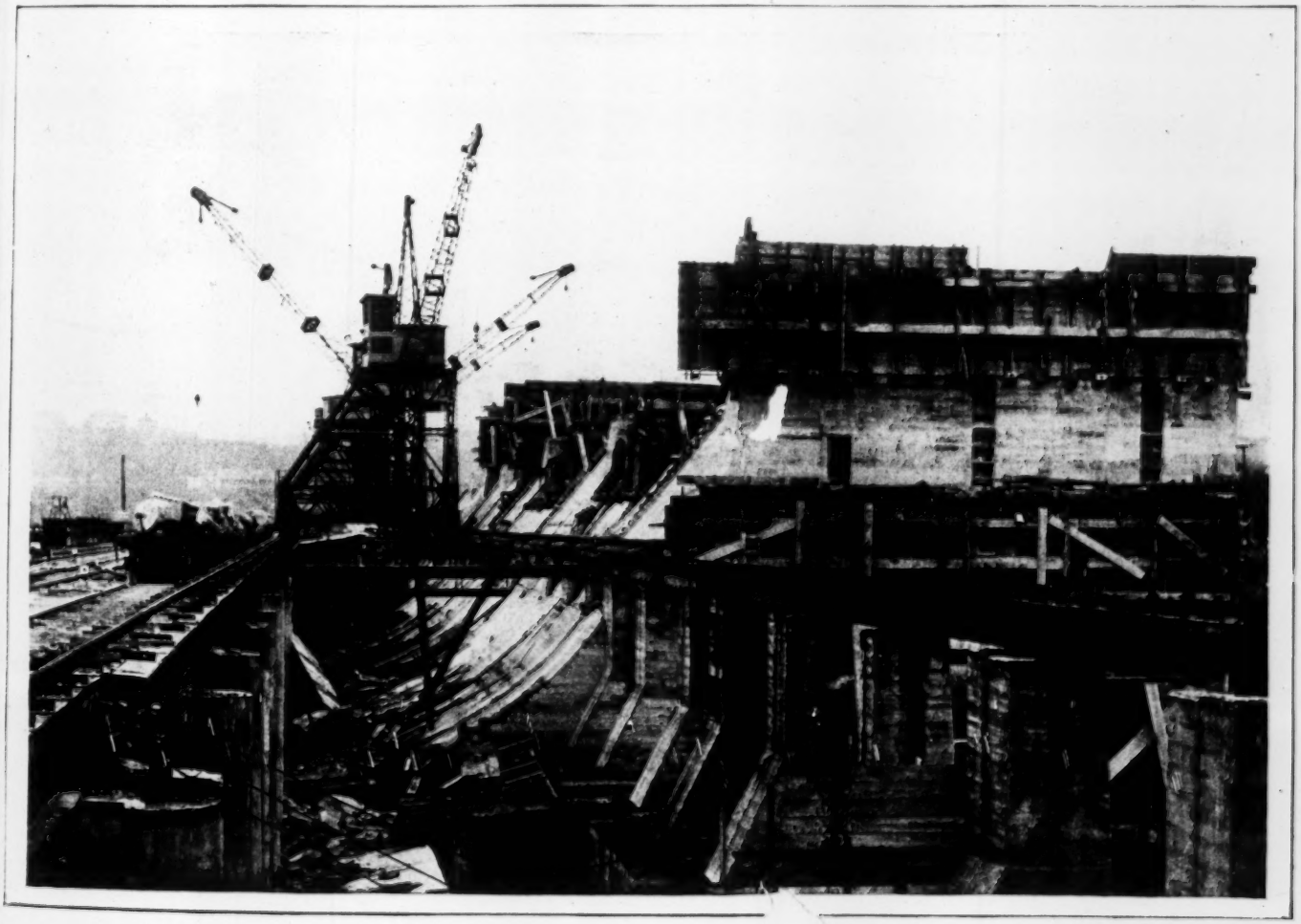
A Gypsum Block Floor System

Precast L-shaped block made in nearby yard successfully used in construction of reinforced-concrete apartment house in Buffalo, New York.

Building Wilson Dam at Muscle Shoals

The largest dam now under way being built by U. S. Army Engineers on Tennessee River. Progress made up to shutdown ordered by Congress.

Looking Across Tennessee River at Wilson Dam Showing Railway Trestle and Crane Runway



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ENGINEERING NEWS-RECORD

DEVOTED TO CIVIL ENGINEERING AND CONTRACTING

E. J. MEHREN, Editor

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Freight by Container

A CAR specially designed for truck-body-freight-containers, used in store-door delivery service, has been put in operation by the New York Central lines between Chicago and Cleveland, as noted elsewhere in this issue. Previously these columns have urged a full trial of the motor truck in railroad terminal service and have pointed to line haul of container-bodies as one of the possible extensions of such a system of operation as is now employed at Cincinnati for the interchange of less-than-carload freight between railroad main and sub-stations. The published tariff for the new store-door delivery service states that it is for the purpose of trial. While team-track cranes already existing will be used for transfer of containers between car and truck, expansion of the service may dictate some revision of less-than-carload terminal layout and the use of specialized handling equipment. Here there will probably be large opportunity for skillful adaptation of existing facilities to an improved system of operation.

Keeping a Big Job Going

EVEN in flush times, million and a quarter-yard concrete jobs are not commonplace. The size, therefore, adds all the more interest to the description in this issue of the construction organization and procedure in building the Wilson Dam (formerly known as Muscle Shoals Dam) in Northern Alabama. In such a project the big problem is to assure the uninterrupted flow of materials, and to show how that was provided for on the job in question is the principal purpose of the article on page 537. It warrants the careful reading of both engineers and contractors.

Fate of Wilson Dam Project

LESS than two weeks after the article on the Wilson Dam appears, work on the huge project will come to a standstill. After spending $17,000,000 on the project, the government, speaking through Congress, has decided to let the job lapse. What will be done with it cannot be foretold with certainty. When the last administration went out of office there was no plan. Now some light appears. The new Secretary of War, Mr. Weeks, states that if a lessee can be found to operate the plant on terms that will give the government a reasonable return on the investment, he will recommend to Congress the appropriation of sufficient funds, approximately $30,000,000, to finish the plant. Chief opposition to further appropriation in the last Congress seemed to be due to an unwillingness to have the government operate the plant—presumably in connection with the nitrate plant built at Muscle Shoals as a war measure. Certainly the investment already made should not be allowed to remain idle if, on completion, the plant can be operated on a sound economic basis. If it can be, and the government is willing to make a contract that will fairly safeguard the contractor, there will undoubtedly be tenders for the operation of the plant. Moreover, even if the return that can be secured is not what one would expect from a privately financed venture it is obvious that it might be cheaper for the public to incur a minor loss rather than lose the entire interest on the $17,000,000 already spent and fail at the same time to get any income toward amortization. The negotiations which will likely ensue as a result of Secretary Weeks' statement will make interesting reading.

Wage Deflation

LAST week's acceptance by the packing-house employees of wage cuts of 8 cents an hour for time workers and 12½ per cent for piece workers is significant of labor's appreciation that wages must come down. The agreement covers plants widely scattered and, while it does not effect arrangements that have the national character of the railroad wage agreements, it comes nearer having a national import than any but the railroad labor situation. The proposals made by the packers were not acceded to in full. The basic 8-hour day is retained and all agreements made by Judge Alschuler acting as "administrator" or arbitrator will remain in effect until Sept. 15 of this year when they will terminate. Another indication of labor's appreciation that the wage trend must be downward was the decision of the marine workers at New York to accept a reduction which would wipe out the advances made to them by the Railroad Labor Board last year. The reductions here referred to are, of course, an essential part of the industrial deflation process and their special significance lies in the fact that they have been effected by arbitration and without strikes.

Disparities in Highway Bids

DURING the past few weeks bids have been received for the construction of hundreds of miles of highway in four of the large road building states, New York, Pennsylvania, Ohio and Illinois. While the types to be constructed in these four states have not been identical there has been enough of a general similarity to indicate a wide disparity in the bids. Ohio and New York have secured fair prices and have put many miles under contract. Peculiarly, in these two states no contract is awarded which is in excess of the engineer's estimate. Illinois' prices do not seem to be excessive, while Pennsylvania felt justified in rejecting most of the bids because they did not reflect the downward price trend. But why, for instance, should a contractor's bid for almost identical work be much higher in Pennsylvania than in New York? Is there justification for wide difference in per-mile costs for like types? Is that difference accountable by the physical character of the territory through which the road is to pass? Are

the specifications and the spirit of enforcement held to be a greater risk in the one state than in the other? To those questions we have tried to get answers, but without satisfactory results. It would help highway engineers and contractors greatly if the facts could be impartially set down.

Getting Together on Highway Policy

WHILE Congress recently was considering highway legislation we urged editorially that all who are interested in the continuance of federal appropriations for highway work should get together and go to Congress endorsing a single plan. The soundness of that advice has been borne out by what actually happened in Washington during the closing days of the session, as recited in the news section of *Engineering News-Record* week before last. A highway measure appropriating $100,000,000 passed in the House but failed to come to vote in the Senate, due to the opposition of Senator Townsend, who insists, in the face of an overwhelming sentiment for the federal-aid policy, upon pushing the "national highway" plan. The determination to push the national plan in Congress was born at a time when it seemed impossible to secure extensive federal-aid appropriations. Since the vigorous propaganda for the national method began there have been liberal appropriations under the federal-aid plan, while repeated Congresses have given evidence that the country, at least so far as it speaks through its representatives, is committed to the policy of building roads with the joint use of federal and state funds. That being established, it behooves the advocates of the national plan not to allow their efforts to defeat federal highway appropriations entirely. That is just what they did in the last session. They defeated the appropriation, moreover, not on its merits but through parliamentary tactics. What direction our highway expenditures may take at a later stage of highway development need not be discussed now. For the present the country is committed to the federal-aid plan and it would be well if all advocates of highway expenditures would get together and agree upon that form of use for federal highway funds.

Results of Highway Research

THE extremely rapid expansion of highway transportation during the last year or two has emphasized the acute need for research work of a type never before demanded. It requires only a brief study of the nation's motor vehicle statistics to indicate that today's problems cannot be solved by yesterday's formulas.

Road failures during the past twenty years can be classified into three main groups: The first of these, covering the period of the waterbound macadam road and the horse-drawn vehicle with steel tires, is made up of failures due principally to abrasion; roads actually wore out under traffic. In the second group the type of failure is completely changed by the swiftly moving rubber-tired automobile which drew the binder out of the road surface, resulting in a loosening of the stone, rapid ravelling and a dust nuisance. This condition led to types of construction in which bituminous binders were employed. In the third group great weight transmitted by solid rubber tires, with accompanying impact forces depending, among a variety of other factors, upon kind and condition of tires, speed, height of obstruction or drop encountered on the road surface, and the amount of sprung and unsprung weight, play a prominent part. This type of road failure, as contrasted with the first two, is essentially of a structural nature and is far more serious than its predecessors inasmuch as it involves not merely the surface but the whole depth of the pavement and, in many cases, the foundation as well.

This structural conception of highway design, while comparatively new, is now widely accepted. With it came the realization of the utter lack of information regarding such subjects as the impact of motor trucks and the resistance of various types of road to it, the supporting values of various kinds of subgrade materials, subgrade drainage and the distribution of pressures through road surfaces of various types to the subgrade.

For some time past the U. S. Bureau of Public Roads has been conducting investigations in each of these specialized fields, and the first comprehensive report on the work is summarized in an article on p. 553 of this issue, dealing with the measurement of motor-truck impact. Descriptions of the method were made public a year or more ago. While the report is a preliminary statement of results and presents no final conclusions, it is a document of far-reaching importance. The pioneering work with which it deals has been in progress for two years and has involved a wide variety of tests with different types of trucks, loadings, tires, both pneumatic and solid, speeds, and heights of obstruction or drop. Nothing approaching in scope and completeness the present data on impact has ever been secured. In fact, study of vehicle impact might be called original with the bureau. The report is the first step in a quantitative determination of the effect of motor transport on highways.

It should be clearly understood that the present data deal with only one phase of the general problem—the *amount* of impact force. Supplementary information on the other closely related subjects, enumerated above, will be forthcoming later. With such basic data in hand, co-ordination and interpretation of results will open the way to the establishment of sound methods of highway design and construction, and sound policies regarding vehicle regulation, thereby insuring, to a degree now unknown, the economical expenditure of the vast sums which will be devoted to roadbuilding work and the protection of highways from unreasonable use by overloaded trucks.

The report carefully avoids any statements which could be constructed as definite conclusions, but it does give a summary of what it terms the "indications" of the tests in so far as they have progressed. Impact depends to a great degree upon tires—not only their type but also their condition. Even though very wide, solid-rubber tires which are worn or thin produce extremely high impact forces, while the effect of pneumatic tires in reducing impact is marked. In extreme cases impact as high as 7 times the static load on one rear wheel was recorded with a solid tired truck, although the average value was about 4 times the static load. For pneumatic tires, on the other hand, the average impact value is not more than 1¼ times, and, in extreme cases, not more than 1¾ times the wheel load. A decidedly important indication of the tests is that, under certain conditions, light-weight, high-speed

trucks produce as high impact forces as heavy, slow-moving vehicles.

Containing data which may ultimately cause radical changes in highway design or in motor-vehicle construction and equipment, the report is an indication of the returns that may be expected from the expenditure of money for highway research.

Construction Responsibilities

WHO pays the losses involved in a mismanaged piece of public works construction? About half a million dollars, at the least count, was lost—not merely diverted but totally destroyed—in the Cleveland clearwater basin enterprise, recently brought to a close by an important court decision summarized on page 549 of this issue. Who pays for this loss? For the present, no doubt, the money comes out of the Cleveland taxpayers' pockets. But, where the plain fact is that engineers were responsible by making a notorious mess of the entire basin work, will the loss not ultimately fall on the engineering profession, in the discredit and loss of prestige that the case inevitably entrains?

All the responsibility for the failure and its attendant evil history, we regret to say, rests on the shoulders of engineers without a shred of excuse in storm, fire or other act of God, in accidental error of calculation, or in fault chargeable to someone else. Not only this, but blame rests on them, in conjunction with city politicians and lawyers, for attempting to make the contractor pay the piper and in addition deprive him of a considerable sum of money rightfully due him for work done. All this is known, more or less definitely, to the citizens. Not only from the decision but from facts learned long before the decision was rendered, the people know that the basin construction was incompetently and negligently planned, and that all subsequent troubles had origin in this fact. They also know of the preposterous attempt to divert the responsibility for the outcome under cover of the fact that the contractor did a large amount of very bad work. Is it to be expected that they can retain high regard for a profession that lends itself to such proceedings? Refuge will try to be found in the contention that the engineers were honest and that, at least in urging or abetting the suit, their judgment was in error; but granting such contentions, they do not weigh heavily in the face of the facts disclosed.

In checkmating the attempt to hold the contractor accountable for the engineers' faults, and at the same time condemning him to full payment for his own bad work, the court decision gives powerful support to sound practice in public works. Primarily, this inures to the interest of the public, but it will also benefit contractors and engineers. Should it accomplish nothing else than to eliminate or make less probable such bootless contentions as those on which the clearwater basin case was built up, it will be of lasting value.

Contractors will find in the illuminating analyses and findings of the master and court renewed assurance that when they do public work they may count on ample protection of their rights and need not fear ruin so long as they themselves do not fail of performance. Perhaps no essentially new points of law are brought out, yet some old points are presented in distinctly new light. This is done both in the findings of the master, by which he brushes aside many of the cobwebs with which the technical facts of the case had been surrounded and in the court's application of the principles of law to a number of matters vital to the contractor: the validity of a contract in the face of ambiguous clauses concerning available funds, the right to recognition of completed performance, the right to prompt acceptance, the binding character of liquidated-damages agreements, and the obligation to pay for repairing faulty work. Going behind the decision to the facts of the case, the contractor will also find it instructive to note that his own responsibility in connection with a public works contract is a very real one, and that if he allows the dictates of hurry or the negligence of employees to jeopardize the quality of his work he may land in bankruptcy. There is no apology and no relief for bad work.

And, much more forcibly, there is no apology or relief for bad engineering. The clearwater basin was a total failure because, in the first instance, the preliminary exploration and the fundamental planning were inadequate. Indeed, the whole filter plant of which it is a part was affected most seriously by the same cause, and its history of reconstruction and restoration attempts is not yet ended. But this was only an initial error. On top of the routine adoption of a conventional design of structure, incapable of resisting settlement such as was to be expected in the soil at the site chosen, there came inadequate inspection and lack of that team work between contractor and engineer in the field which assures safe control and direction of the undertaking.

Minor though the last mentioned point may seem, it is perhaps the most significant of all. Thorough engineering in the field would have exposed the earlier mistakes and under favorable circumstances would have made their correction possible. Whoever follows the case through attentively, indeed, will be impressed with the fact that the missing co-ordination of owner and contractor was perhaps the most serious single fault of the whole enterprise. Explorations are more or less perfect, generally less; and designs are often nothing more than paper guesses; but the engineering that is done in the course of the actual construction is the finally determinative work, and will make or mar the result. The obligation upon the engineer to inspect the work and therewith to direct and control the construction enterprise is compelling and inescapable.

Reducing the whole to its elements, it may be said that the case restates the truth that conscientious engineering and fair dealing with the contractor are indispensable to sound results in construction. In respect to conscience and care as well as in respect to fairness, a responsibility rests on the engineer that he cannot evade.

In a case with so many sobering and anxious features for the engineering profession, it is a satisfaction to see also an illustration of what the engineer can do in furtherance of sound public relations, even far outside his narrow field. An engineer, acting as special master, played a determining part in straightening out the tangle of technical facts in which the case had become involved, thereby leading up to a constructive court decision. Robert Hoffmann's contribution to the analysis of the dispute is a significant and gratifying feature of the case. It demonstrates that under the right circumstances the engineer can help as much in the sound handling of law as, we hope, the lawyer can hold in keeping engineering on a footing of equity.

Million and a Quarter Yard Concrete Job Was Carried on Rapidly at Wilson Dam

Description of Construction Plant That Was Placing About 40,000 Yards of Concrete Per Month—Main Concreting Plant Equipped With Four-Yard Mixers

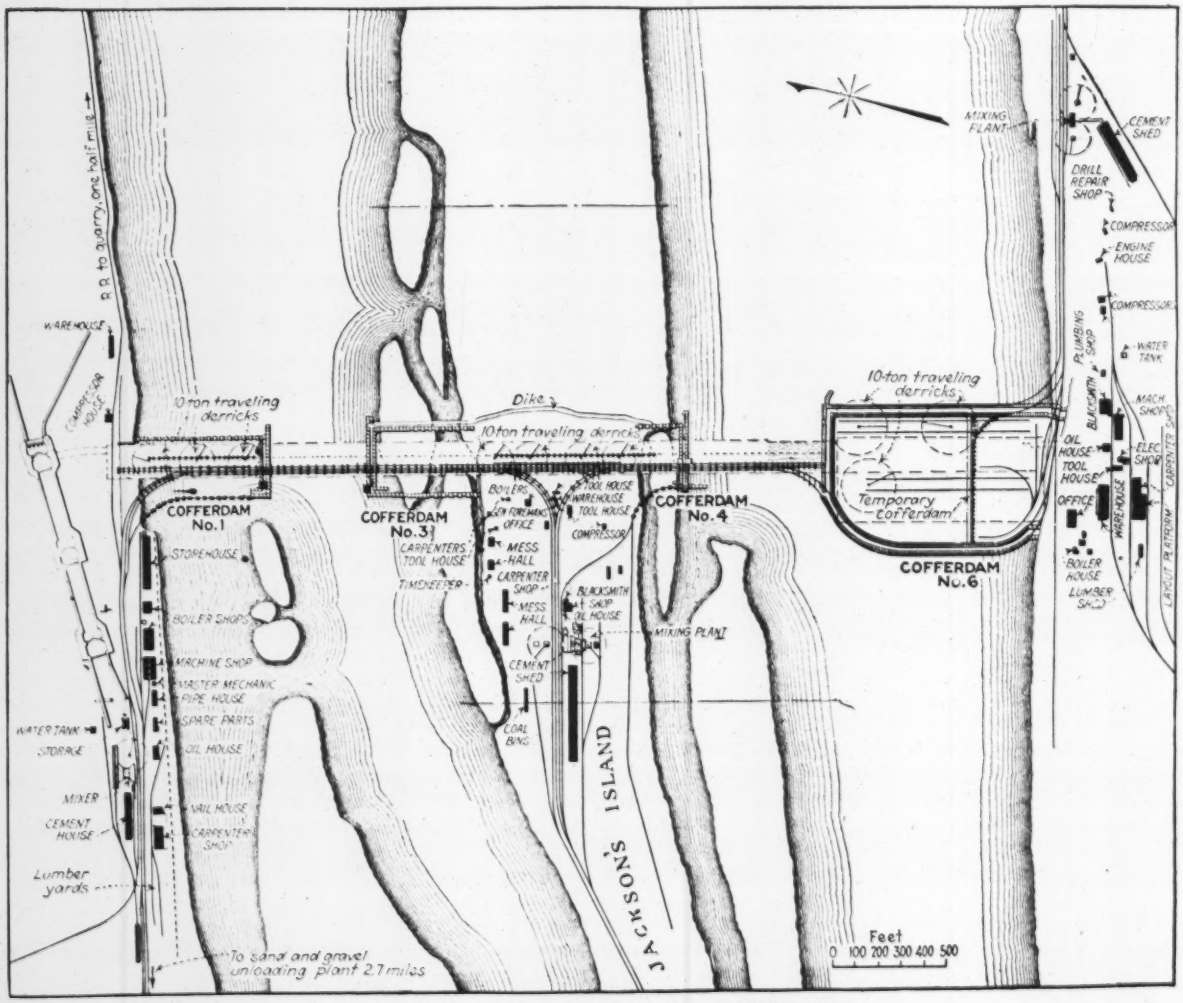
STARTED in 1918 and seriously delayed several times, the construction of the Wilson Dam in northern Alabama, known more widely under the name of the Muscle Shoals Dam, was going ahead rapidly when Congress shut the work down. Concrete pouring began on a large scale last October. In that month 28,000 cu.yd. were placed; in November, 26,000 cu.yd.; in December, 40,000 cu.yd.; in January of this year, 38,000; in February, 37,000 cu.yd. These yardages were entirely in the dam. In addition 5,000 cu.yd. were placed in the power house in February. Meanwhile all supply sources have been developed so as to allow of continuou full-capacity operation on both dam and power house.

To the end of February approximately $13,500,000 have been spent on the project, out of a total estimated cost of $50,000,000. The structures when completed will contain 1,260,000 cu.yd. of concrete masonry.

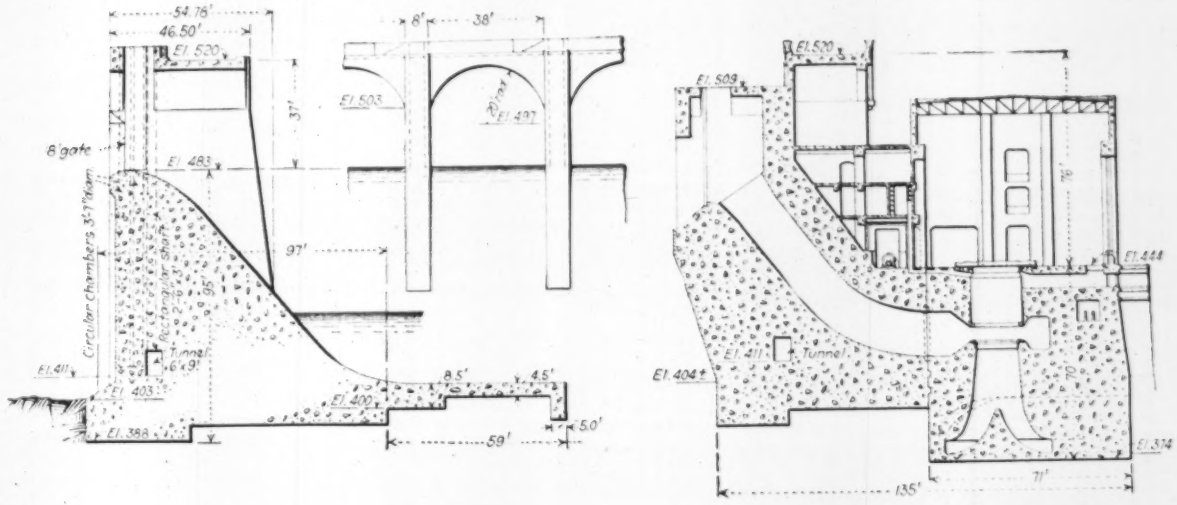
It is proposed in this article to describe only the construction plant and the general construction procedure. Only so much information will be given regarding the design as will enable one to comprehend the task that as set before the construction engineers.

Structures to Be Built—The Wilson dam is a gravity-section concrete structure located at Muscle Shoals, in the Tennessee River, about 2½ miles upstream from Florence, Ala. The total length is 4,111 ft. The spillway section has a length of 2,890 ft., while that portion in which the power house is incorporated has a length of 1,221 ft. In this description repeated mention will be made of the "power house," but it is to be understood that that structure is built integral with the dam itself and on the same axis as the spillway section.

The dam crest is 80 ft. above the elevation of the river bed, and will carry gates 18 ft. high, raising the water level to a height of 98 ft. above the stream bed and creating an available maximum of about 500,000 hp.



LAYOUT OF CONSTRUCTION PLANT, WILSON DAM



Section Through Main Dam — Section Through Power House

CROSS-SECTION THROUGH DAM AND POWER HOUSE

Four units of 30,000 hp. each have been contracted for, and space for fourteen additional units is provided in the power-house design. Carried above the crest of the dam will be a roadway bridge.

On the north bank (the power house is on the south side) will be a flight of two locks, each 60 x 350 ft. between hollow quoins (300 ft. available length).

The project has long been under discussion by the Corps of Engineers, U. S. A., but no action could be secured until the war necessity for nitrate arose. The construction was then authorized (in April, 1918) under broad powers granted the President, to be paid for out of funds placed at his disposal by Congress, with the exception of using the current in the nitrate plant or plants to be built at or near the dam site. Work was suspended by order of the War Industries Board on Aug. 21, 1918 and was resumed on Nov. 9 of that year. The reorganization of forces was commenced at once, but owing to the scarcity of men and materials and unfavorable winter and river conditions, little progress could be made until the beginning of the spring of 1919, at which time work was resumed in earnest and the first cofferdam was completed. Meanwhile work was concentrated on a steam power plant and on the nitrate plants themselves, with the result that nitrae plant No. 2 was put into operation before the close of the war, though with purchased current, the steam plant not being finished until long after the armistice

In 1919 work was again resumed on the dam, the first cofferdam being completed and pumped out about the middle of the year. Subsequent delays were caused by changes in design, and full-swing concreting operations were not possible until October, 1920.

As has been stated, approximately $13,500,000 have been spent to date and the government is obligated for an additional expenditure of $525,000, by reason of contracts for four turbines and $779,000 for four generators. Funds available permitted of full operations only through February and an additional appropriation of $10,000,000 requested from Congress was refused. Consequently work is now being shut down as rapidly as possible with a view to retaining enough of the funds now available to care for the plant, property and buildings for a reasonable period.

The thought of the advocates of the project is that the current will be chiefly used for nitrate manufacture in nitrate plant No. 2, the product being sold in peace times for agricultural purposes. The construction, it should be borne in mind, however, has had no connection with the nitrate plants and it is the latter, and not the dam, that are referred to when the Muscle Shoals plant, or the Muscle Shoals project, of war days is mentioned.

Skeleton cross-sections herewith show the spillway and the power-house sections of the dam and give an idea of the work involved in the construction.

The Construction Task—The construction task may be quickly visualized by calling attention to the site conditions and to the chief quantities involved:

1. On the north bank the nearest railroad connection (with the Louisville & Nashville) was 2½ miles away; on the south (with the Southern Ry.), 3 miles.

2. The nearest town was not only 2½ miles from the site, but lacked rail connection with the dam site and was unable to care for the 4,500 persons whose services would be required in connection with the construction. Consequently it was necessary to build at the site a camp of very large proportions.

3. The stream is a flashy one, subject to enormous flood increases, the average summer minimum falling to about 12,000 cu.ft. per second and the maximum (recorded in a flood in 1897) increasing to 500,000 cu.ft. per second. This involves, in an unobstructed river, a maximum rise of 33 ft.

4. The excavation required amounted to 620,000 cu.yd. distributed as follows: Locks, 228,000 cu.yd.; power house, 216,000; dam, 176,000. The lock excavation is in the dry; the power-house and dam excavation, principally in the stream bed.

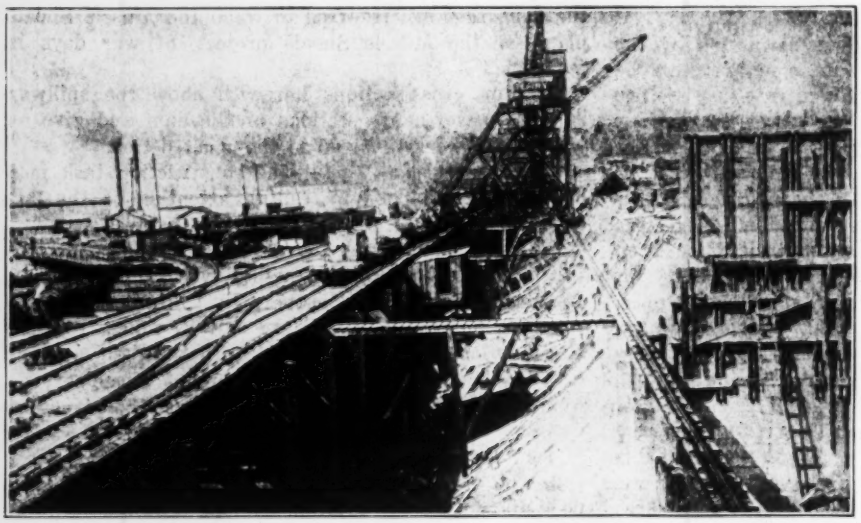
5. The concrete masonry involved totaled, as already stated, 1,260,000 cu.yd., and was divided as follows: Dam and bridge, 665,000 cu.yd.; power house, 498,000 cu.yd.; locks, 72,000 cu.yd.; miscellaneous, 25,000 cu.yd.

Construction Procedure—The diagram herewith shows the layout of the construction plant. The scheme, in the main, consists in building on the downstream side of the dam a construction bridge, carrying four lines of standard-gage track across the north channel and three

MARRIED NEGRO QUARTERS; SOME OF THE PERMANENT RESIDENCES IN THE FOREGROUND

lines across the south channel. This bridge is of substantial construction—steel girders on concrete piers—so as to withstand the floods that are likely to sweep over it in times of high water. The tracks on the bridge connect with the rails of the railway systems reaching Sheffield on the south bank and Florence on the north bank, thus allowing for deliveries to any part of the work from either of the trunk lines. The installation of four lines across the north channel (one more than over the south) is due to the greater traffic over the former, for across it must come all the sand, gravel, and the plum stones for the concreting operations.

On the downstream side of the dam, between the crest and the construction bridge, is a 38-ft. gage track for the cranes which remove the rock from the dam foundation and handle forms, plum stones and concrete.



CRANE TRACKS AND CONSTRUCTION BRIDGE ON DOWNSTREAM SIDE OF DAM

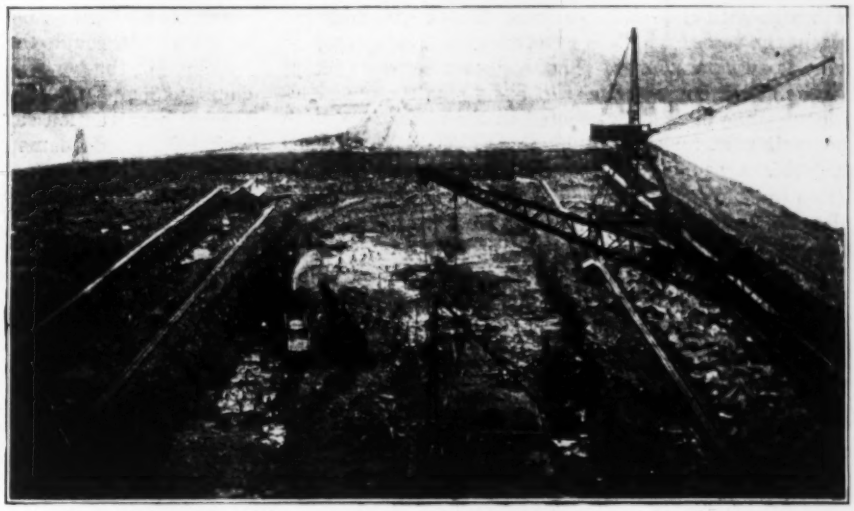
The location of the construction-plant service buildings is clearly shown on the plan. As will be noted, there are separate groups on the north and on the south banks, the former being intended for the equipment and service on the dam operations proper and those on the south bank for the equipment and service required in building the power house.

The heart of the job is the main mixing plant on Jackson Island, for upon its output depends the progress of the principal item of the work, the concrete masonry of the dam. From it tracks lead in both directions along the dam, and while a separate mixer plant is provided on the south shore to serve the power house, concrete for the latter could be secured in case of necessity from the Jackson Island plant. The capacity of the main mixer plant was determined largely by the equipment that could be employed with reasonable continuity for taking rock out of the dam excavation, handling forms, and placing concrete. The handling equipment on the dam consists of seven Terry full-circle cranes, traveling on the track previously mentioned, and having a capacity of 10 tons at 75-ft. radius. Two of these cranes work together on each of the blocks of the dam and can each handle twenty 4-yd. buckets of concrete per hour; that is, the two cranes can put 160 cu.yd. of concrete in place per hour. To keep these cranes served, the mixing plant was equipped with two 4-yd. Smith mixers. Allowing for three minutes in the drum per batch, the mixer turnout synchronizes with the capacity of the placing cranes. The best concrete run for an 8-hr. shift has been 1,060 yards.

Obviously on such a large job continuity of operation needed to be given careful thought. For that reason ample provision is made for large reserve storage and for sufficient equipment to keep up the rate of progress in case of breakdown of individual units. This is illustrated by the storage capacity provided at the main mixer plant—20,000 cu.yd. of gravel and crushed stone, 15,000 cu.yd. of sand, and 25,000 bbl. of cement. Moreover, in case of shutdown of the main plant by accident, the concrete reserve plant on the north shore can be called into service without blocking traffic on the construction bridge. At a later date, when through tracks are finished across the south channel, even the south shore plant could be called upon for reserve service. The shore concrete plants are both equipped with two 2-yd. mixers. That on the north shore will be used chiefly for the mixing of concrete for the locks. A cement warehouse of 15,000 bbl. capacity is provided at the north bank concrete plant, and one of 25,000 bbl. capacity on the south shore, giving a total capacity on the job for storing 65,000 bbl. of cement, a provision believed wise in view of the difficulty experienced last year in securing adequate and continuous supplies.

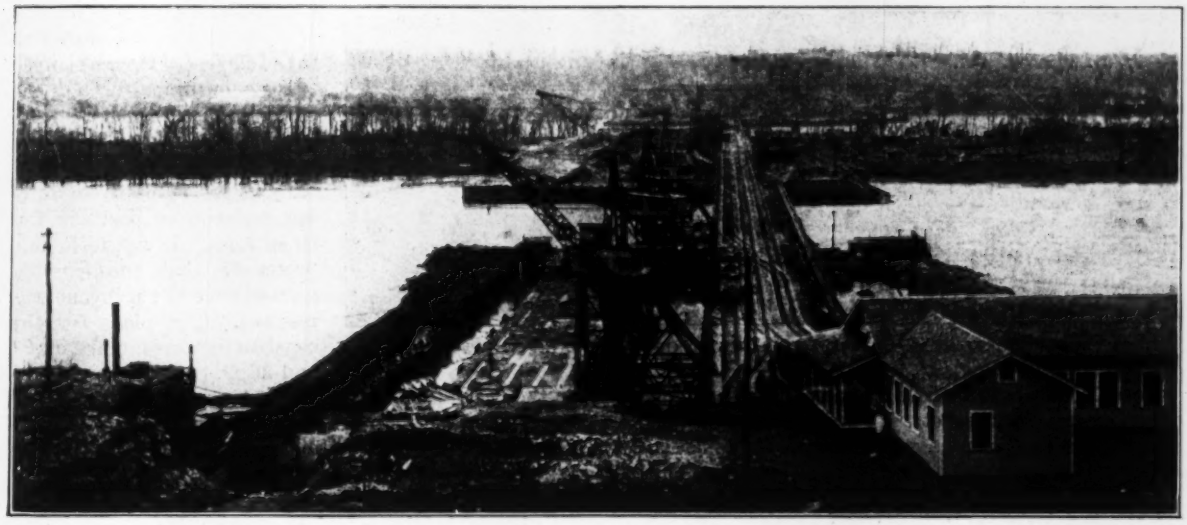
The bridge trackage, to emphasize again the provision

o secure adequate plant capacity, is ample to keep the various services going without interference. Two tracks are available across the north channel for service between the shore and Jackson Island, leaving the other two for haulage of concrete, forms, etc., to the dam itself. Across the south channel there will be less through traffic than from the north shore to the island, and three tracks are expected to prove ample. At present only one of the tracks across the south channel is completed, but work upon the remainder of the construction bridge and trackage is actively under way.



TWELVE-ACRE COFFERDAM INCLOSING POWER-HOUSE SITE

In normal concreting procedure on the dam two standard 40-ft. flat cars are hauled in a train by a 25-ton locomotive, each flat carrying three of the 4-yd. buckets. The cars are large enough for four buckets each, but in order that the concrete shall be dumped as soon after mixing as possible the number of buckets is limited to six to a train. The center-to-center spacing of the mixers themselves, by the way, corresponds to double the spacing of the buckets on the flats, so that alternate buckets, should four be used to a car, can be filled at one time. The 4-yd. buckets, stated to have given excellent service, were built by the Atlas Car Co., of Cleveland. Two-yard buckets are provided for concreting the piers of the bridge and for narrow and small parts of the work.



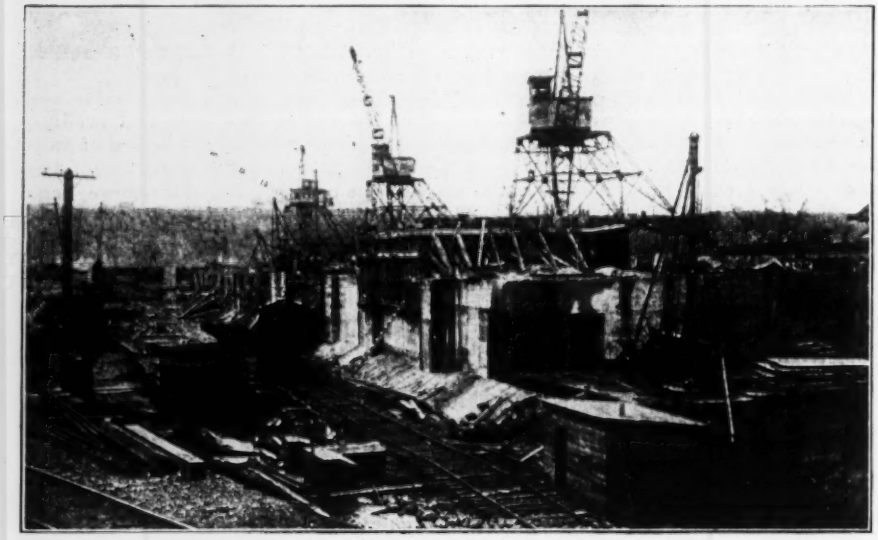
GENERAL VIEW OF JOB; INSIDE FIRST COFFERDAM CAN BE SEEN FOUNDATION OF DAM, CRANE RUNWAY AND CONSTRUCTION BRIDGE

Concreting in the power house will be handled with the aid of three McMyler full-circle cranes, traveling on tracks laid on sills on the stream bed. These cranes have masts 100 ft. high, have 115-ft. booms, and a capacity of 10 tons at 118-ft. radius. They will handle the buckets from flat cars to place.

Procedure of Work—The first work attempted, aside from the building of the camp, the filling and grading of a railroad yard on the north shore, the laying of railroad track on the north shore and the provision of the service buildings, was the construction of a narrow-gage railroad line across the north channel from which the piers of the construction bridge could be built. The line was carried on timber cribs and over it came the pier forms and concrete, both handled to place by derrick boats conveniently moored. The completion of the north channel construction bridge and the tracks thereon enabled excavation to begin in the dry on Jackson Island, and also the erection there of the main mixer plant, the accompanying cement warehouse and certain service structures.

The construction of cofferdam No. 1 on the north shore of the river proceeded simultaneously with the construction of the bridge, and as soon as possible, the construction of cofferdams 3 and 4 (on the north and south shores of Jackson Island) and cofferdam 6 (inclosing the power house site) were taken in hand. River arm and down stream cofferdams consist of two rows of 16 x 16 ft. stone filled round-timber continuous cribs

with a sheeted clay chamber from 12 to 20 ft. wide between, the top of which is covered with a thin layer of stone to serve as riprap. The upstream coffers (except for the power house) consist of but a single row of continuous stone filled cribs sheeted on the upper side, with the sealing material filled in above. It will be noted that this arrangement provides for submerged river action in time of flood without injury to the coffer dams. All cofferdams were originally built to a height of 14 ft. above ordinary low water, but cofferdams 3 and 4 have been raised to a height of 20 ft. above ordinary low water (26 ft. above the stream bed) and cofferdam 6 to a height of 17 ft. above ordinary low water (21 ft. above the stream bed). All cofferdams are subject to overflow in freshets, but, so far, overflow has occurred only once. The extra height given to the Jackson Island and power house cofferdams saved those two dams from being overtopped in a recent freshet.



BLOCK OF WILSON DAM CARRIED TO HEIGHT OF 43 FT. ABOVE RIVER BED

The procedure adopted with a view to handling the floods is as follows:

1. Except for the portion on Jackson Island and 400 ft. adjoining the lock on the north shore, which will be carried up to crest height at once, the entire dam is to be built with alternate sections open to pass the stream discharge. Sections 12 ft. long are to be carried to crest height and from them will rise 8-ft. piers to carry the roadway bridge. Between these 12-ft. blocks the dam will be carried up only to El. 411, thus leaving alternate 12-ft. blocks and wide openings. The openings will be alternately 30 and 38 ft. wide, this variation being due to the fact that though the bridge piers are placed uniformly on 46-ft. centers, the additional width of 4 ft. (to make the 12-ft. block) is added on one side of the pier.

2. Work was rushed on the portion within cofferdam 1 until all concrete was brought up to El. 411, or higher. This was accomplished during January last, and the cofferdam was then removed, thus giving additional area for passing the spring floods.

3. Work in cofferdams 3 and 4 will also be pushed hard, so that the cofferdams there can be removed and allow cofferdam 2, across the present open part of the north channel, to be built. The entire flow would then be diverted through the south channel and through the openings in the portions of the dam built within cofferdams 1, 3 and 4. It is hoped that by the end of the present construction season all the piers in the portions included in cofferdams 1, 2, 3 and 4 will be up to full height.

4. In the spring of 1922 it is planned to close with a cofferdam the opening in the south channel (to be called cofferdam 5) thus diverting the flow to those portions built within the four earlier cofferdams. It is the expectation that by October, 1922, the roadway bridge will be completed for the entire length of the dam and all open sections up to El. 411, so that work may then begin, in regular procedure across the whole length of the dam, to build in the openings up to full crest height.

5. During all these operations there will be no disturbance of cofferdam 6, inclosing the power-house site, so that without interruption work may proceed therein on excavation of foundation and tailrace and the placing of concrete.

Under the plans as originally made a different method of construction procedure was to be followed. It was planned to leave openings through the bottom of the dam for its full length, the whole dam being built up to full crest height without the necessity of forcing water over partially finished work. It was to fit this procedure that the existing construction layout was planned. The piers for the construction bridge are on 23 and 36 ft. centers while those for the crane-track vary from 14 to 24 ft. centers, and were spaced so as to avoid the originally planned temporary openings. Moreover, since no water was to come over partially finished work, the upstream crane rail could be left on the downstream face of the dam without any change in the existing construction layout, until closure was completed. The openings through the base were later to be closed by gates on the upstream face and the tunnels concreted.

However, when the present consulting engineers were called in they advised in favor of the procedure which is now being followed, being fearful that the channels in the base of the dam might become choked with drift and prevent the closing with gates. Under the present method of procedure, the upper crane rails, suported by the piers to be incorporated in the concrete of the dam, will of necessity have to be removed, except below that portion of the dam closed off by the temporary bulkheads, as soon as the concrete in the closure openings has been raised two lifts. As closure proceeds, the crane rails will be removed below completed lifts and placed, under protection of the bulkheads, behind that portion of the dam in which the six foot lifts are being placed. In this manner, it is hoped to be able to use the Terry cranes to complete the entire work notwithstanding the change in plan of construction.

Excavation—The excavation within the stream bed is entirely in Lauderdale chert, a hard cherty limestone. On both banks, however, the strata above the Lauderdale chert consists of Keokuk limestone. Large quantities of this had to be excavated at the lock site and the dam abutment on the south shore. The Keokuk limestone is easily handled, but the chert is very hard and is difficult to drill. The drilling and blasting procedure, however, offers no particular points of interest. Spoil was removed from the dam foundations in skips and handled by the Terry cranes to 20-yd. side-dump cars. At the power-house site part of the excavation is similarly handled by the McMyler cranes, but the greater part of it is handled by steam shovels, loading directly into cars. Inclines and switchbacks connect the tracks within the excavation area to the running tracks on cofferdam 6. Spoil areas were conveniently located on Jackson Island and on both the north and south shores.

The character of rock encountered in the lower lifts of the power-house excavation was suitable for crushing for concrete and at present the spoil is being taken to the crusher plant located at the main mixer installation on Jackson Island, the crushed stone being used not only for the dam concrete but being hauled back to the south shore concrete plant for use in the power-house structure.

Air compressor plants are located on the north shore and on Jackson Island for supplying compressed air for work on the dam section, and another plant on the south shore supplies the air needed on the power house section. The plant on each section has two machines and has a capacity of about 4,000 cu.ft. of air per minute.

Materials Supply—Sand and gravel are secured from river bars about 12 miles below the dam. Two suction dredges, equipped with washing screens, are in operation at this point, and the materials are brought by barges and tow boats to a dock at the Florence bridge, 2½ miles below the dam site. Here the materials are removed by two gantries equipped with 4 cu.yd. buckets and deposited in a storage bin, having a capacity of 1,500 cu.yd. of gravel and 750 cu.yd. of sand. From these bins gravel and sand can be dropped directly into side-dump cars and hauled to the mixer plant.

Plum stone, crushed rock and crib filling stone is secured from a quarry on the north bank about half a mile above the dam site. The greater portion of the rock in the lock excavation is used as plums or for crushing.

Cement has been purchased from six different companies, and in order to insure a supply last year when the car shortage was so serious the government bought seventy-nine standard-gage boxcars, which were used exclusively in cement service from the plant of the Lehigh Portland Cement Co. at Mitchell, Ind. By this means the job was kept in a continuous supply of cement during last summer.

Miscellaneous Equipment and Facts—Brief mention of the quantities of some of the equipment, chiefly of that not already mentioned in this article, will give some idea of the "planting" of the job. The equipment inventory shows that there are thirty locomotives, ranging in weight from 25 to 60 tons; seventy-nine standard box cars; fifty-six standard flats; seventy eight dump cars, practically all of 20 cu.yd. capacity seventeen locomotive cranes; ten steam shovels; two 15-in. suction dredges; three tow boats, and twenty sand and gravel barges. At the main mixer plant on Jackson Island is a crushing installation consisting of a 48-in. Allis-Chalmers crusher, operated by a belt-driven 300-hp. motor and six 12-in. crushers.

The Terry cranes have a mast height of 67 ft. and boom length of 83 ft. The capacity, as previously stated, is 10 tons at a 75-ft. radius.

With the exception of the concrete mixers, the derricks and the locomotives, practically all of the equipment is electrically driven, power being purchased from the Alabama Power Co. and brought to the job over high-tension lines.

There are approximately 28 miles of standard-gage railroad track, not including that upon spoil banks, in excavations and in other locations where it is subject to frequent shifting. In other words, there are 28 miles of running track. Eighty-pound rail has been used exclusively in all tracks, and in the judgment of the construction superintendent has fully warranted the outlay.

The piers for the construction bridge are on 36-ft. centers, while those for the crane track on the dam are on 23-ft. centers. The piers for the construction bridge were put down in depths of 7 to 8 ft. of water. All foundations are on rock. In fact, the rock is clean across both channels.

Organization—All work and design are under the general supervision of Maj.Gen. Lansing H. Beach, Chief of Engineers, U. S. Army.

The construction is under the direction of Col. W. J. Barden, Corps of Engineers, U. S. A., district engineer. The work is divided into five chief divisions: Engineering, under Lt.-Col. W. C. Weeks, Corps of Engineers; administration, W. M. Williamson, which has charge of the camp and its administration, and also of the employment of labor; supply, under Maj. S. C. Godfrey, Corps of Engineers, which purchases all supplies and has charge of disbursements; construction division 1, which takes in the dam proper and the locks, under Joseph Wright; construction division 2, the power house, under Maj. John S. Butler, Corps of Engineers.

Hugh L. Cooper & Co., of New York, are the consulting engineers, responsible for the design.

At the beginning of March about 4,600 men were on the payroll. All civilian employees are under civil service.

To house the workers and take care of the necessary services a camp of 517 buildings has been required. This number of buildings is exlusive of the buildings directly connected with the construction operations.

Business in Agricultural Engineering

That the training of agricultural engineers should include more attention to commercial aspects is the opinion of Stanley F. Morse, consulting agricultural engineer, New Orleans, as expressed in his presidential address to the Southern section of the American Society of Agricultural Engineers. This will necessitate higher salaries to secure instructors of wide practical experience. Lectures by farm operators, agricultural engineers and county agents may form part of the course, and frequent visits should be made to profit-making farm enterprises. Students should have more field work by placing them on well-managed farms and plantations during the summer, and new graduates should be assisted to secure minor positions with concerns engaged in commercial farming.

Operating Costs of Engineering Practice

Factors Include Education, Capacity, Class of Work, and Direct and Indirect Expenses of Business—Cost Keeping

IN ANALYZING the cost of an engineer's practice the factors are of great variety and those to be included will depend upon the class of service performed. There are involved also the kind of organization, the kind and extent of area tributary to the engineer's location, the time and manner of developing the business and the educational work of the engineer for himself and for his client. It has been said that if all engineers engaged their services on the same basis, the engineering profession would receive ultimately what it is justly entitled to for services rendered and clients would have a better understanding of what they receive for the prices paid. This condition has led to an analysis of cost of engineering practice by C. H. Young, president of the Central States Engineering Co., Muscatine, Iowa, for the purpose of establishing a basis for standardization of charges for service. At the annual meeting of the Iowa Engineering Society he presented his methods and results in a paper which is abstracted below:

Engineers may be classified by the character of their practice, as follows: (A) One who has his office at home and operates a one-man practice; (B) one who has a small office, employs assistants for part of the time and operates a one-man practice for the remainder of the time; (C) one who has a business organization, stenographer, chief engineer and departments employing a number of men so that he may perform various classes of service; (D) one who holds a position which provides office equipment and salary and who devotes part time to private practice; (E) a professor who devotes excess time to private practice; (F) an engineer who consults only on large projects along a particular line; (G) one who does some contracting and fills in his time at engineering.

Cost of Education and Equipment—An engineering education is the foundation for a superstructure of engineering practice. Considering that the cost of a college education is $500 per year and that different classes of engineers would require four-year and six-year courses, some engineers would acquire a larger part of their education from their personal ability to study out problems in their own way. Table I presents the cost of education and equipment for engineers of the seven classes. Equipment covers tools, fixtures and transportation facilities. For classes D and E it is assumed that only 25 per cent of their time would be given to engineering practice, because of other duties. For practical experience a five-year period has been assumed.

Promotion—Promoting jobs, dues to associations, etc., as the engineer must keep up with the times. He must also watch the changes in different bodies of men and keep them in touch with his qualifications.

Bonds—The cost of surety bonds amounts to 1 per cent of the penalty of the bond or 1 per cent of the bond required. As the amount of the bond furnished is fixed by the parties requiring it, this is an indefinite expenditure, but it is an item paid by the engineer.

Insurance — This represents the cost of workingmen's compensation which is compulsory under the State Law. It fluctuates from time to time.

Traveling—This includes traveling to jobs that are not obtained and visiting jobs under construction in order to secure information. Many trips are necessary to get final settlement on the work after it is completed. This item

CENTRAL STATES ENG. CO.
DAILY REPORT

Client's Name_____ Date_____

Employees Name_____ Hrs. Worked_____

Nature of Work_____

EXPENSE	AMT.	PAID	REMARKS
Auto			
R. R. Fare			
Transfer			
Brdg. Toll			
Meals			
Lodging			
Stakes			
Stationery			
Misc.			

REMARKS _____

FIG. 2. CLASSIFICATION OF EXPENSES FOR CLIENT'S BILL

CENTRAL STATES ENGINEERING CO.
OF MUSCATINE, IOWA

IN ACCOUNT WITH

YEAR MONTH	Date		Chief Engineer	Asst. Engineer	Draughtsman	Field Helper	Transportation	Meals Lodging	Miscellaneous	TOTAL

FIG. 1. ASSISTANT'S DAILY JOB REPORT (3x5 IN.)

TABLE I. CAPITAL INVESTMENT COST OF AN ENGINEERING PRACTICE

Class of Engineer's Service or Practice	Cost of an Engineering Education: Four Years	Six Years	Five Years' Practical Experience	Necessary Capital: Equipment	Money in Accounts	Total Capital Necessary	Total Amount of Business Including Wages Expenses
A	$2,000	.....	$1,000	$2,000	$2,000	$4,000	$4,500
B	2,000	.....	1,500	3,000	4,000	7,000	6,500
C	2,000	.....	3,000	8,000	12,000	20,000	30,000
D	2,000	.....	500	2,000	2,000	4,000	1,200
E	.....	3,000	1,000	1,000	1,000	2,000	1,500
F	.....	3,000	3,000	2,000	2,000	4,000	6,500
G	2,000		2,000	3,000	4,000	7,000	2,000

NOTE.—25% of time for D and E considered available.

also includes expenses to attend society meetings in order to keep up with the times.

War Tax—This is an item on all cost, as it represents the tax not only on profits but also on telephone, telegraph and express bills.

Interest on Investment—This must be a part of all estimates of cost, amounting at present to 7 per cent.

Interest on Jobs—This is interest on money borrowed to carry on work, for engineers must receive their wages and expenses must be paid whether or not collections are made. Very few assistant engineers have enough money to wait until preliminary expense is paid by the job. Again, a great many warrants must be discounted from 1 to 4 per cent, dependent upon the credit of the project, because the banks have to hold these warrants until the bond issue is put through.

Discount—As mentioned above, it is necessary sometimes to discount warrants and hold bills between Board meetings. Sometimes these warrants cannot be cashed for several years.

Job Expense—This includes miscellaneous transportation of men, expense of lost time for men receiving steady pay, storage, job office rent, etc.

Repairs—Repairs to tools and equipment; tools lost or stolen.

Depreciation—Every engineer has depreciation on his equipment which amounts to 10 per cent per annum on its cost. In some cases this should be doubled.

Risk—This factor is indeterminate. Sometimes during preliminary surveys the bills are not paid. The preliminary bond may be insufficient or the work may be held up by legal procedure so as to delay the engineer's pay. Money must often be borrowed for an indefinite time to carry on business and discounts.

Office Expense—Stenographer, rent, light, heat, janitor, postage, telephone, telegraph, control systems, books, supplies, advertising and similar expenses which every business must pay.

Salaries—This is a local question and would be determined easily by a summation of the salaries paid during the year, but it is hard to anticipate just what salaries should be paid on any particular job because of the fluctuation of the other factors involved. The several items or cost factors encountered in an engineering business or practice are listed in Table II, so that the engineer may recognize that such factors exist, if he has not realized it.

Cost-Keeping and Organization—In this company's practice, job tickets (Fig. 1) are made out in duplicate for each job each day, one being filed under the client's name and one under the employee's name, for making up the bill and salary respectively. These tickets are 3 x 5 in., filed in a card index box. They are put up in books of fifty tickets and each man makes out his own ticket. In transferring the items to the client's bill they are entered under several headings on the form shown in Fig. 2.

TABLE II. COST FACTORS IN ENGINEERING BUSINESS

Class of practice (A to G) — Items.
Continuance of business
Vacations
Lost time
Personality
Natural ability
Personal application
Efficiency
Promotion
Bonds
Compensation insurance
Fire insurance
Life insurance for business security
Traveling expense on jobs secured
Traveling expense on jobs lost
Traveling expense to society meetings and educational trips
War tax
Interest on investment
Interest on jobs
Discount
Repairs
Renewals
Depreciation
Risk
Stenographer
Rent
Light
Heat
Janitor
Postage
Telephone
Telegraph
Control systems
Books
Supplies
Advertising
Miscellaneous office
Salaries
Cost keeping systems
Bonus
Collections
Organization outlines
Training of new employees
Education of clients
Personal improvement and education

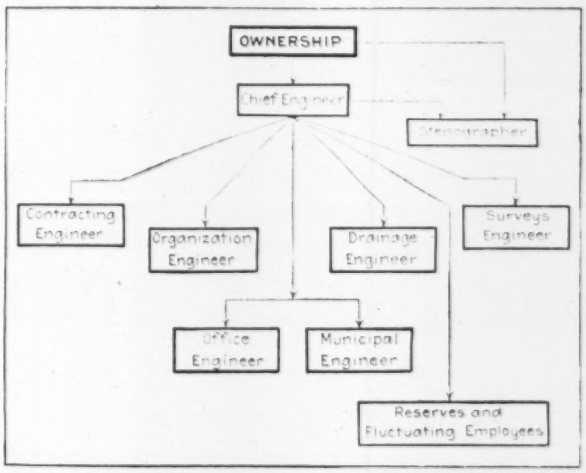


FIG. 3. ORGANIZATION CHART OF AN ENGINEERING FIRM

Engineers operating in Class C, especially, must devise some operating plan to transmit the responsibility to the various departments. Much expense can be saved clients where men in different departments are experienced in a particular class of work, thus rendering competent service which could not be rendered by one engineer who would not be versed in all kinds of engineering business. In Fig. 3 is shown an organization which might be a factor in successful operation and consequently a factor of cost.

One factor that is indeterminate but must be taken into account is the loyalty of the employee and his abidance by the ethics of the profession. This item may be very large when men have to be trained over and over again to fill the different departments of the work. While it is always a gratification to the engineer to see his employees advance, there comes a limit to the amount of salary that can be profitably paid.

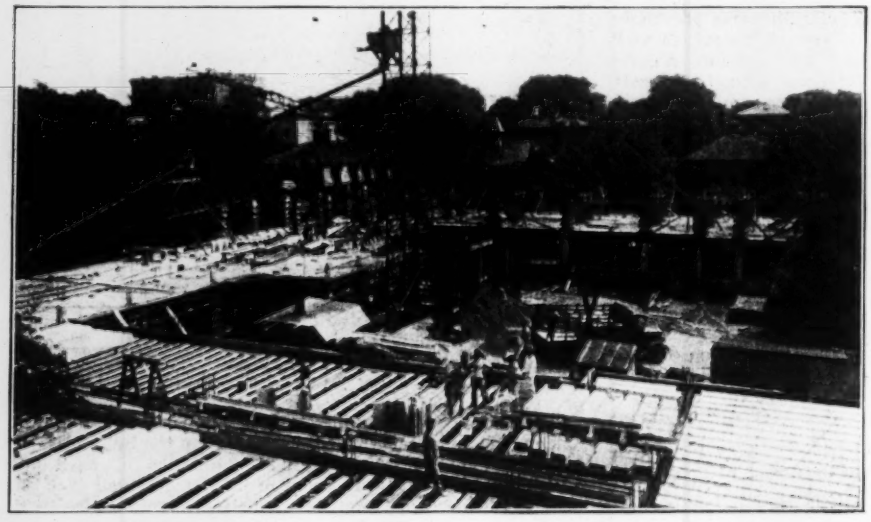
Whether or not the employee would receive an apportionment of the profit would depend upon his loyalty, his attention to business, the success of his work and the class of service the engineer performed. And again it would depend upon the value of business over a period of years, taking the good years with the bad years, the successful collections of accounts, and the education of clients.

Use Special Light Gypsum Blocks In Floor Construction

Economical Construction Results from Light Weight Floor of Interlocking Gypsum Tile in Reinforced-Concrete Building

By A. V. Bekay
Chief Engineer, Barney-Ahlers Construction Corp., New York City

IN THE floor construction of a seven-story reinforced-concrete frame apartment house, recently built in Buffalo, N. Y., a new form of light gypsum tile blocks, producible on a quantity basis, were used in a manner of the well-known tile and joist systems. The lightness of the gypsum block resulted in a decided saving in the weight of the reinforcing steel and the supporting members of the building. The dead load of the floor system was far below that heretofore attained in this type of construction. The ready production lent itself to a low price for the tile, appreciably below that currently paid for a corresponding terra-cotta or a tin-pan tile. The ease in handling, coupled with the excellent plant layout and construction organization, made possible the finishing of the building ten days ahead of an already close speed schedule. In other words, all of the well-known advantages of the terra-cotta tile or tin-pan floor systems, that is in formwork and rapidity of construction, were further added to by economy of production and greater economy of design. A further saving also resulted from the fact that the tile provided a smooth ceiling for the grounds of the plastering. The plaster was put on in a very thin two-coat work, giving a proper finish for apartment occupation.



GENERAL VIEW DURING CONSTRUCTION SHOWING METHOD OF HANDLING CONCRETE MATERIALS

The building is symmetrical about the center line, except for a few openings. The beams and girders were confined entirely along the corridor partitions, thus giving an unbroken ceiling throughout. The columns were arranged to project only into the corners of the unimportant rooms. This was accomplished by keeping two faces of the columns flush for the entire height of the building.

The details of the typical floor construction are shown in the drawings. The L-lock floor tiles were supplied by the Ellok Corporation, Buffalo, N. Y., and were fabricated a short distance from the site of the work. The Ellok plant for manufacturing these tiles consisted of a long single-story building, built directly along a railroad siding, where the raw gypsum and other materials were stored under cover. Along each side of the building were arranged two sets of individual molds. The blocks were manufactured and set up ready for handling so rapidly, that by the time the liquid material was poured in the last mold of a row, the first blocks were ready for removal and curing, preparatory to their being trucked to the site of the work. In other words, there was a steady supply of this important part of the work directly to the job. Due to the excellent organization and interest of the Ellok Corporation, which could be duplicated under similar conditions, the construction was not delayed by the tile.

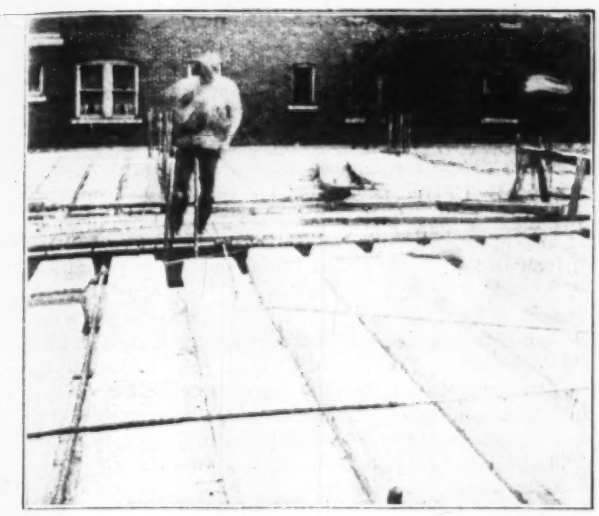
Six-inch deep tiles were used for the short spans and 8-in. for the long spans. The 6-in. weighs 36 lb. per tile and the 8-in. 40 lb. Each tile covers an area of 20 x 30 in. Reducing it to a square foot basis, the weights are 8½ and 9⅓ lb., respectively. These weights are decidedly less than for the usual terra cotta tile systems and a considerable saving in the reinforcing steel resulted.

One of the drawings shows the typical method of formwork used. In general the forms consisted of 2 x 8-in. planks, 20-in. centers, placed directly under each concrete joist and in turn supported by a series of stringers about 4 ft. apart. This type of formwork proved to be very economical and the ease of stripping permitted the use of practically one set of forms for the entire structure. In order to obtain a level ceiling, the forms were lined up with unusual care, with a maximum allowable variation of ¼-in.

Owing to the advantages of the continuous bottom, the setting of the tile was easily accomplished. The trough for receiving the concrete joists was formed by simply laying the upper section of the tile over the lower section. Time and money were thus saved, as no shifting or lining up was required, as is the case with the usual systems of individual units.

Upon removing the formwork a smooth flat ceiling was obtained. The ceilings were finished by applying a very thin two-coat work of plaster. The tile eliminated the customary heavy three-coat plaster ceiling as is required with the ordinary tile and joist construction and the furring and lathing as is necessary in the tin-pan joist system. Repairs to the ceiling can be readily made by cutting out a section of the tile and replacing with plaster boards and plastering over same.

A careful inspection by the architect, in which practically every tile was tested and considered as to alignment, resulted in only about 250 tiles having to be

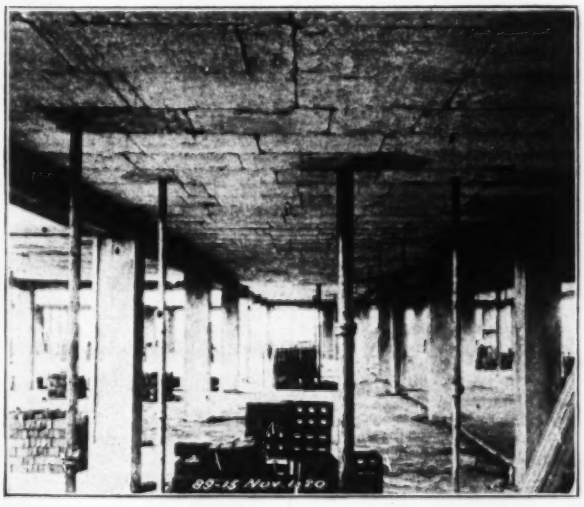


VIEW OF THE GYPSUM TILE IN PLACE

replaced or repaired. This in a large measure was due to the damages done by cutting for various other trades, such as for plumbers and electricians.

In general two bars were used in each joist, one straight and one bent. Wire-chair bars were cast into the lower section of the tile. The 2-in. concrete slab over the tile was reinforced with ¾-in. round bars spaced 24-in. centers. The joists adjacent to, or under, the various room partitions, were provided with extra reinforcement to carry the additional loads.

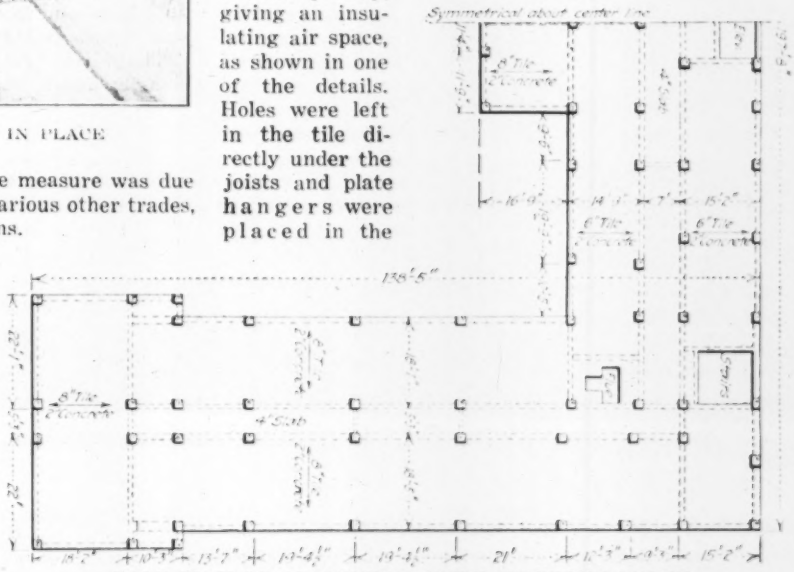
The corridor construction is shown in one of the details. This consisted merely of a 4-in. reinforced-concrete slab and was poured entirely separate from the joist construction. No provisions were made for continuity, owing to the great difference in the spans of the two types of slabs.



GYPSUM BLOCK CEILING FORMWORK REMOVED

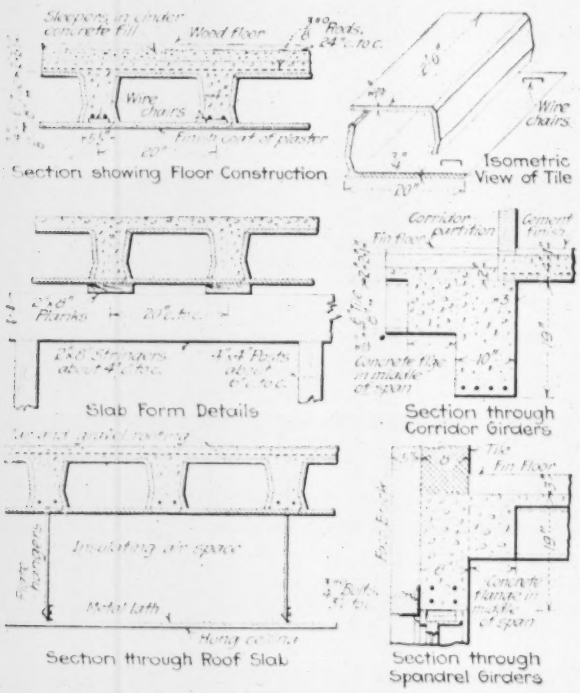
The drawings also show a section through the typical girders. The concrete flange was provided for, by stopping the tiles short of the girders and using plaster board end pieces. These flanges were used only in the middle half of the girders. The length of a standard tile being 30 in., special tiles varying in length from 12 to 24 in. were used to fill out the odd places.

A section through the typical spandrel girders is shown. A continuous steel angle, bolted to the concrete, was provided to support the brick facia. Galvanized iron anchors were used to tie the brick into the concrete and were placed in the forms before concreting. The concrete frame was entirely covered with the brick facia on the front and court, but was left exposed on the sides and rear. A hung ceiling was provided for in the top story, giving an insulating air space, as shown in one of the details. Holes were left in the tile directly under the joists and plate hangers were placed in the forms before concreting. The concrete in the slabs, girders and the upper story columns was of a 1:2:4 mix and the lower story columns of a 1:1:2 mix. Test specimens 6 in. in diameter and 12 in. long were cast of the general run of the concrete as deposited in the forms and were tested for compression. These cylinders were made in pairs, one set for each floor.



HALF PLAN OF APARTMENT HOUSE, CONCRETE FRAME AND GYPSUM TILE FLOOR

The plant installation and general method of handling the work was carefully laid out before the plant was shipped to the site. The plant consisted of a chuting system, with a steel tower, erected on the inner court, opposite the center portion of the building. The boom and the counterweighted section of the chuting system, by swinging through a large arc, enabled the placing of the concrete directly throughout the entire floor. The columns were poured one or two days previous to the pouring of the floor slab, thereby giving greater stability to the form structure and allowing for the full shrinkage of the columns' concrete. This procedure gave an opportunity to clean up the floors previous to the placing of the steel in the joists, beams and girders. A ¾-yd. batch mixer was placed sufficiently below grade to enable an economical handling of the concrete ingredients. The sand and gravel was excavated and screened directly from the Niagara River.



DETAILS OF GYPSUM TILE FLOOR SYSTEM

A large timber bulkhead was built against the back side of the mixer and the ready-mixed sand and gravel which was delivered by trucks, was dropped as close as possible to this bulkhead. A common scoop, such as is generally used for scraping and excavating work, was handled by one man and pulled by the same hoisting engine that was used for lifting the concrete in the tower. A cable was brought over the sheaves to form a straight lead toward the top of the pile. When the cable was slack, this man would haul the scoop backward down the pile and on a signal the hoisting engine would pull the new load up to the top of the pile, thereby giving a constant source of supply for the mixer. In front of the bulkhead was a storage platform.

The tile was somewhat brittle but with the spouting system the concrete work proceeded economically and successfully. Because of the high efficiency of the plant and a constant supply of materials, excellent progress was made. The first floor slab was poured on July 12 and the last pent house roof slab was poured on Oct. 16, ten days ahead of schedule, making a total of fourteen weeks to complete the reinforced-concrete structure.

J. W. Wilson of Detroit, Mich., was the architect for the building and the Stuyvesant Properties, Inc., the owners, who let the various features of the building direct. The reinforced-concrete structure and floor system was designed and built by the Barney-Ahlers Construction Corporation, of New York City, for whom the writer acted as chief engineer on this project.

Per Capita Lumber Consumption

In the United States the per capita lumber consumption was highest in 1906 at 515 ft. b.m. In 1900 it was 460 ft. and 20 years previous, 360 ft. In 1913 it had dropped to 430 ft. and by 1918 was down to 300 ft. The estimated 1920 consumption is 307 ft. From 1851 to 1911 the consumption in England increased from 40 to 120 ft. and in Germany from 1840 to 1900 it doubled, reaching 150 ft. France now uses 90 ft.

Factors Determining the Duty of Water in Irrigation

By Justin T. Kingdon
Consulting Engineering, Cheyenne, Wyo.

In order to show the various and interrelated factors which determine the use of water in irrigation the classification given below has been prepared for use in court cases and is based upon the chart accompanying an article on "Factors Determining the Duty of Water in Irrigation," by H. F. Robinson, supervising engineer, U. S. Indian Irrigation Service, in *Engineering News-Record* of Aug. 21 1919, p. 355. This newer scheme may be useful to engineers and others engaged in irrigation development as a guide in the analysis of conditions on new projects and for the improvement of conditions on projects already in operation. Some repetition in the factors is unavoidable because of their interrelations.

The term "duty of water," as applied to irrigation, is understood generally to mean the amount of water actually needed to grow a crop. In view of the many varied conditions found in practice, the accompanying classification covers rather the broader subject of the "use" of water. Under this application the "duty of water" may be defined as the amount of water artificially applied in growing a crop.

Factors Affecting the Duty of Water in Irrigation

Fixed Factors

1. Precipitation: A. Quantity. B. Distribution.
2. Water resources available.
3. Climate: A. Humidity. B. Length of growing season. C. Altitude. D. Latitude. E. Evaporation. F. Temperatures (a, favorable; b, unfavorable).
4. Topography: A. General. B. Local.
5. Geology: A. Kind of soil. B. General surface and subsurface structure.

Factors Subject to Change

1. Economic conditions:
   A. Crops grown.
   B. Cost of water.
   C. Transportation of crops (a, hauling to market; b, local sale; c, local feeding).
   D. Hired labor (a, availability; b, cost; c, skill; d, reliability).
   E. Labor not hired.
   F. Financial problems relating to the control of water supply through (a, public administration; b, community or company management; c, the individual consumer).
   G. Stage of irrigation development.
   H. Preparation of land.
2. Length of irrigating season.
3. Stage of watershed development; A. New. B. Intermediate. C. Settled.
4. Stage of land development; A. New. B. Intermediate. C. Settled.
5. Crops grown.
6. Soil cultivation; A. None. B. Ordinary. C. Careful.
7. General soil conditions; A. Raw land. B. Unsettled. C. Settled.
8. Skill of the water user.
9. Position of the water table.
10. Water supply (see separate classification below).

Water Supply (Factor Subject to Change)

1. Quantity.
2. Distribution.
3. Quality.
4. Temperature.
5. Use: A. Municipal. B. Domestic. C. Stock. D. Irrigation.
6. Control: A. Direct flow. B. Storage. C. Storage needed but impracticable.
7. Characteristics of individual streams:
   A. Geology of channel: (a, tight; b, porous; c, character of stream bed).
   B. Habits: (a, normal; b, flashy; c, debris; d, silt).
8. Delivery to irrigators: A. Continuous. B. Rotative. C. Careful control. D. Individual responsibility when the water is under (a, private ownership, b, public control)

9. Availability: A. Based on priority. B. Based on riparian rights. C. Whenever desired. D. Outside the growing season only. E. Indeterminate.

10. Losses of water:

A. Stream. 1. Location of priorities. 2. Geology of channel. 3. Problems of delivery. 4. Return Seepage.

B. Irrigation works: 1. Storage (a, seepage; b, evaporation). 2. Transportation (a, seepage; b, evaporation).

C. Field: 1. Deep percolation (a, kind of soil; b, ditches poorly arranged; c, too small an irrigation head; d, poorly graded land; e, faulty attention). 2. Evaporation from the soil: (a, no cultivation; b, average cultivation; c, careful cultivation; d, faulty attention). 3. Avoidable surface waste; (a, faulty delivery; b, faulty distribution; c, poorly graded land; d, faulty attention). 4. Unavoidable losses: (a, deep percolation; b, evaporation; c, surface waste).

D. Miscellaneous losses in delivery of water for: (a, domestic use; b, stock purposes).

FACTORS WHICH MAY BE CORRECTED

1. Control of water: A. Public administration. B. Community company management. C. The individual water user.

2. Errors in adjudication: A. State administrative board or court decree. B. Granting rights to the use of more water than is economical.

3. Basis of payment: A. Bulk quantity delivered. B. Amount delivered as continuous flow. C. Acreage irrigated.

Expressways Proposed to Relieve N. Y. Traffic Congestion

C. W. Leavitt Suggests Elevated Vehicular Routes —Amos Schaeffer Analyzes Cost of Plan

TO RELIEVE traffic congestion in the Borough of Manhattan, New York City, a number of north-and-south elevated vehicular expressways through the centers of existing city blocks and vehicular tunnels under Central Park were proposed by Charles W. Leavitt, landscape engineer, at the meeting March 16 of the New York Section of the American Society of Civil Engineers, which was devoted to a discussion of the subject "Streets and Parks of the Metropolitan District." The routes suggested for these new traffic ways are as follows:

1. Between 1st and 2nd Aves., from 24th to 127th St.
2. Between 2nd and 3rd Aves., from 10th to 128th St.
3. Between 5th and 6th Aves., from 8th to 59th St.
4. Between 9th and 10th Aves., from 14th to 110th St.
5. Between 10th and 11th Aves., from 17th to 73rd St.

Extracts from Mr. Leavitt's paper follow:

Connection between the ground and these elevated expressways should be made every ten blocks or so, by ramps leading to the less traveled ways, such as 15th, 24th, 35th Sts. Wheeled vehicles from the expressways should not be brought into already over-crowded ways such as 14th, 23rd and 34th Sts. Pedestrian approaches might be made more often, by stairways or ramps. Arrangements could be made for stopping automobiles on the sides of the express ways, as here doubtless will be popular locations for stores because of the passing traffic. In the center there might be through roadways, where speed could be attained with no interruption from cross traffic.

It has been suggested that these expressways be constructed as overhead tunnels, using the roofs for access to adjacent buildings. This would mean closed vehicular passageways above ground. While gas fumes make closed tunnels for automobile traffic impossible at present, the improvement in locomotion which rightfully may be expected some day will relieve this condition and make it possible to use motor vehicles in tunnels both above ground and underground. This would permit the projecting of the vehicular express way between 5th and 6th Aves. from 59th St. in the form of a subway under Central Park, and make it a most desirable means of entrance and exit to and from the city.

At first it might seem a Herculean task to destroy enough buildings in the center of blocks to permit the construction of these thoroughfares but, if it is done under an excess condemnation plan, the city should reap a return far greater than the cost of condemnation. One hundred feet on either side of an express way might be condemned and sold after the express way is put through. The added ratables also would be a source of income and, moreover, there would be made available much property now more or less inaccessible. The space under the express ways could be used for garages, storage houses, parking, service entrances to store basements, etc.

COST OF PLAN ANALYZED

Discussing Mr. Leavitt's proposals, Amos Schaeffer, consulting engineer to the borough president of Manhattan, presented figures indicating the cost of the expressways suggested; portions of his remarks follow:

Expressways are suggested above and between the avenues in Manhattan for the entire width of the island. Such heroic treatment can only be resorted to after all other efforts for relief have been exhausted. On the assumption that expressways will be 100 ft. wide the assessed value of the land for all is approximately $275,000,000. The price which the city has to pay for property is usually from 50 to 100 per cent in excess of the assessed value. The property necessary for these expressways would, therefore, cost from $412,000,000 to $550,000,000. It is suggested that excess condemnation be applied to an additional 100 feet of land on each side of them, which the city could afterward sell and from which it could reap a return far greater than the cost of condemnation, which would increase taxes and make available property which is now more or less inaccessible. Assuming that the city could sell the excess land at a profit—which is open to debate—it would require a capital of $1,236,000,000 to $1,650,000,000 for the land.

There are approximately 27 miles of expressways, which at the rate or $5,000,000 a mile, would cost $125,000,000. The grading and paving of the lower level of these avenues would cost an additional $15,000,000, which together with the cost of the land makes a grand total of $1,375,000,000 to $1,800,000,000 as the cost of the complete improvement.

A more intensive use of existing highways must be made before new ones are laid out in the Borough of Manhattan. For example, it has been suggested at various times that a subway be built to carry the 6th Avenue elevated railroad traffic and that the elevated structure be converted into a vehicular highway ending at Central Park, where the traffic would be absorbed by the park roads. More immediate relief must be found by a study of local congestion and the application of remedies.

The construction of the Park Ave. viaduct and the high level roadway around the westerly side of the Grand Central Station have been very effective means of relief in the vicinity of 42d St. and 5th Ave. Some further changes are necessary to obtain the maximum benefit from this improvement. The intensity of traffic on the Park Ave. viaduct is as great as that on 5th at 42d St.; the intensity of traffic on Fifth Avenue was reduced after the opening of the viaduct. Traffic observations made about a year ago showed that the intensity of traffic on both thoroughfares was about the same, namely, 6.5 vehicles per lane of traffic per minute. Two years ago the intensity on 5th Ave. was 6.2 vehicles per lane of traffic per minute, while that on the Park Ave. viaduct was 8.8. These observations indicate the greatest intensities during a period of one hour between 5 and 6 p.m.

Particular attention should be given to a study of the zoning law in its relation to transportation. The authorities should make an effort to distribute the private activities more uniformly throughout the city instead of encouraging them to concentrate in one or a few spots. It is not necessary to have promiscuous manufacturing industries located in the same section. It is a convenience to have the retail department stores in one locality so that people may travel quickly and easily from one to another, but it is not necessary to have the garment factories in the same locality.

Conditions of Madison Water Tank After 30 Years' Service

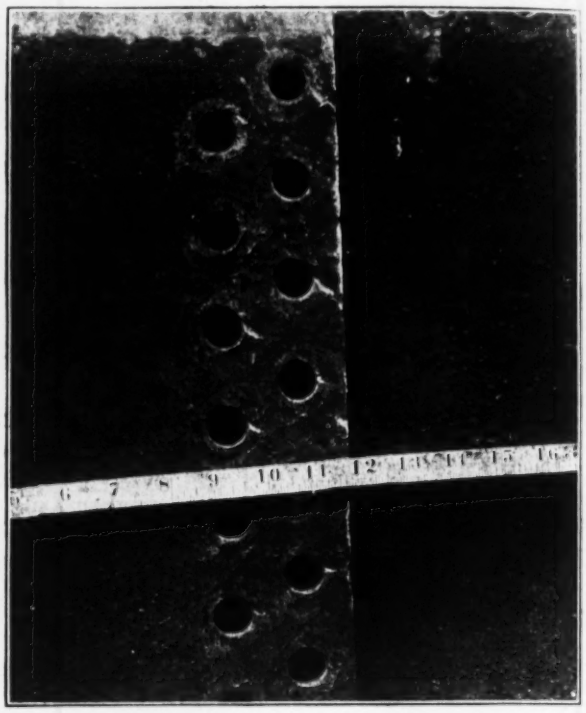
By Walter E. Miller
Civil and Hydraulic Engineer, Madison, Wis.

SINCE those who have to do with public utility valuation and rate making are frequently confronted with the question of proper or reasonable allowance for depreciation, the essential facts concerning the condition of the water tank and supporting and inclosing masonry tower of the water-works of Madison, Wis., at the time of removal after thirty years of service, may be of value to many engineers.

This structure was erected in 1890. Its demolition was completed early in January, 1921. It was removed because (1) the daily consumption of water and the pumping rates had so greatly increased since the tank was erected that the size of the tank became too small to be of material value, and (2), because the tower and tank obstructed an important street. The history of this structure shows how greatly the allowances for depreciation might differ, depending upon whether they include or exclude the functional as well as physical depreciation.

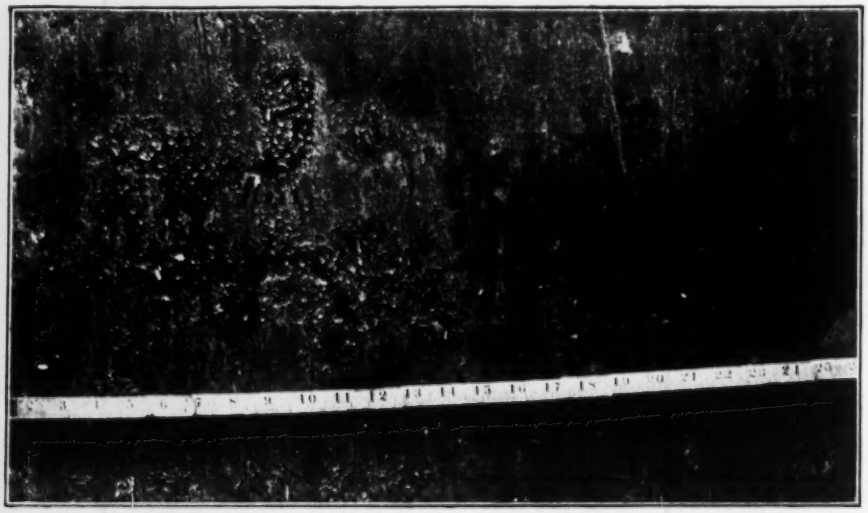
The structure stood in the center of East Washington Ave., one block from the Capitol square. It consisted of a steel tank, 124 ft. in diameter by 60 ft. high, supported and enclosed by a cylindrical brick wall above a one-story square structure of stone masonry. The bottom of the tank was 72 ft. and its top was 132 ft. above the street. The height to the top of the weather vane above the ornamental canopy or roof of the tank was 161 feet.

The tank rested on a grillage of steel rails laid upon four 16-in. I-beams carried by the heavy brick wall. Above the bottom of the tank the wall had three thicknesses, nominally 8, 6 and 4 in. The lower third of that portion was laid in contact with the tank and had a thickness of the widths of two bricks laid flat. For the middle third of the tank the wall consisted of two rings of brick, one laid flat and one on edge, and was 2 in. from the tank. Around the top third of the tank 4 in. from it was a wall one brick width in thickness.



INTERIOR VIEW OF PLATES BELIEVED TO HAVE BEEN IN FOURTH AND FIFTH RING FROM BOTTOM OF TANK
Fifth ring plate has been dropped

Examination of the structure before and during its removal revealed but little deterioration; so little as to make it appear that its thirty years of actual service would be but a small part of its possible physical life. The most noticeable and important deterioration was incipient disintegration of the outer brickwork near the level of the bottom of the tank, but this might have been repaired at moderate expense had the continued use of the structure been desired. Notwithstanding the apparent fact that the tank plates had never been cleaned and repainted the greater part of their surfaces was still well preserved and smooth, although in places the paint was gone and rust had formed. In a few places there was a noticeable pitting of the metal, but in no case had this gone far enough to warrant any apprehension as to weakening of the plates. Some close-range photographs of typical portions of the plate surfaces on their inner or water-side show insignificant deterioration of the metal. The general average condition of the outer surface was somewhat better. It is obvious that only the inner surface could readily have been cleaned and repaired.



WETTED SURFACE OF PLATE IN SECOND RING ABOVE BOTTOM OF MADISON TANK

Important Contracting Questions Decided in Cleveland Clearwater Basin Suit

Litigation Over Unpaid Balance and Cost of Rebuilding After Collapse of Roof Section Five Years Ago—Delayed Acceptance, Measure of Damages, and Certification of Funds Among Main Points Involved

DECISION by the U. S. District Court at Cleveland of a contract suit arising from construction and subsequent partial collapse of a clearwater basin for the city's new West Side filtration plant gives information on a number of perplexing and important questions in public-works construction contracts. Because of the light thrown on contract relations and the wide application of the principles involved, a summary of the case is given below, although an appeal is still under consideration by the city. The court decision as well as findings previously reached by a special master is in substance a complete denial of the city's claims in the case.

A remarkable tangle of events, including entire reconstruction of the basin, led to the original contractor's suing the city three years ago for unpaid balance and extras. The city made counterclaim for damages for delay, *and for the whole cost of reconstruction.* The court referred the case to Robert Hoffmann, chief engineer of the city's Department of Public Service, as master to hear and decide the issues. After hearings in which voluminous testimony was presented, the master reported his findings to the court a year ago, and, upon review of various exceptions to these findings, a decision was finally rendered by Judge D. C. Westenhaver on Nov. 12 last. It approves the master's report except on one point of law involved.

The court rejects the city's claim that the first contractor is liable for the cost of reconstruction decided upon by the city, but requires him to refund payments made for the defective concrete. Liability of the contractor for liquidated damages is reaffirmed, but the contractor is held entitled to reasonably prompt acceptance after substantial completion. In general the decision upholds rules of fair dealing with the contractor, among others the rule that he is not to be held liable for defects of the engineer's planning.

How the Case Originated

Filtration of its Lake Erie water supply was decided on by Cleveland eight years ago, and a large filter plant was laid out on a low lake-front flat a mile west of the central part of the city, between the lake-front bluff and the old channel of the Cuyahoga River, which here runs parallel to the shore. The subsoil conditions were not well known, but some explorations showed much soft material and peat. Ordinary spread footings were adopted for the filter house and the several basins, however.

The design of the plant was made by special filtration engineers retained by the city, headed by the late R. W. Pratt, reporting to C. F. Schulz, then commissioner of water. (For a description of the plant see *Engineering News* of Oct. 19, 1916, p. 732, where general layout plans are given.) That an inadequate view was taken of the foundation conditions became evident very quickly after completion of the major part of the plant, through destructive settlement of the filter house and part of the adjoining coagulation basin, as described in *Engineering News* of Dec. 7, 1916, p. 1099. A pumping station on the same site, founded on piles, has given no trouble in spite of heavy machinery loads.

Design of Basin—The 25,000,000-gal. covered clearwater basin, 195½ x 938 ft. in ground plan, 27 ft. clear inside height, was located close against the bluff bounding the site on the south. Its design, following conventional practice, comprised a lower 6-in. concrete floor on which was laid an upper groined-arch floor 6 in. thick at the crown and 18 in. thick at the columns; gravity side walls; square columns spaced 15 ft. 9 in. on centers; and a groined-arch roof of 6-in. to 12-in. thickness cut into four-column units by construction joints along the center lines of bays. An earth fill of 2 ft. was to be placed over the roof.

A contract for the construction of this basin was let to the Walsh Construction Co., of Davenport, Iowa, on March 29, 1915, and the work was carried out between that time and the end of the year.

Trouble in Construction—Numerous troubles arose during construction, of quite different kinds. Bad ground as well as delays on the part of both engineers and contractor were concerned. The ground in the bluff south of the site slipped and moved, parts of the south wall footings were pushed out of place while being concreted, and part of the floor heaved. Leaking sewer and water pipes contributed other troubles. Trenches for the main conduits showed flow and heaving of the ground. Part of the construction was to be completed in 90 days, according to the contract, but soon after starting the contractor was ordered to wait for changes in plans and could not finally take this part of the work in hand till long after the 90-day limit was over. Delays of various kinds made night work necessary. There was a lack of adequate inspection force, and often no inspectors were present during the night shift.

It is in every way probable that, due both to the delays experienced and to the troublesome nature of the ground, the conduct of the work was under the influence of great hurry part of the time, to the prejudice of careful workmanship. Negligent foremen played a part in this result, it would appear from some of the facts. As to materials, the city selected the aggregate from several samples submitted by the contractor, and through its inspection had continuous control of its quality as also of workmanship and setting of forms. As to cement, subsequent charges of skimping in cement have no foundation, according to testimony presented at the hearings, but the total of cement used exceeded, if anything, that required by the quantities and mixtures.

Disputes—Delayed completion and extra work due to the city's changes and to the emergency troubles encountered led to disputes between the city and the contractor before the work was wholly completed. The bond-issue funds available for the job were exhausted before the contractor had been fully paid. The director of finance stopped payments, although the engineers reported the completion of work amounting to nearly $30,000 more than the certified funds. In January, 1916, the city's engineers reported the job completed,

but the director of public utilities declined to issue a certificate of completion. During the early part of 1916 settlement developed in the basin structure, as was made evident by cracks in the roof and by an outward tipping of the north wall. The basin was filled to a depth of a few feet of water, but on account of leakage at cracks in certain partition walls in the basin it was again emptied.

Roof Collapse—On July 9, 1916, shortly after the basin was emptied, one roof section comprising four columns and four panels collapsed. The stubs of the four broken columns showed diagonal laitance streaking and chalkiness, and in places very bad honeycombing (see *Engineering News*, July 27, 1916, p. 186, and *The Engineering Record*, July 29, 1916, p. 151, for illustrated descriptions of the collapse).

An investigation of the failure was carried out for the city by J. H. Herron, N. C. Johnson, and F. C. Noble, in the course of which many patches, streaks or bands of porous or chalky character were found in the concrete. There was a wide band of this kind in the north wall, where in fact some leakage had been observed previously. Also, flexure cracks showed in the columns, suggesting a northward pressure of the roof.

A reconstruction plan was developed by Messrs. Johnson and Noble for the city, which consisted of building a new reinforced-concrete structure around and inside the old. It included a layer of heavily reinforced concrete over the roof, a similar one on the floor of the old basin, reinforced side walls inside the old, concreted integrally with the new floor and roof work, and reinforced-concrete jackets around the old columns continuous with the new floor and connecting with the new roof by way of openings cut in the old roof around the columns. The city demanded that the Walsh Construction Co. build this new structure, in obedience to the clause of the contract requiring it to repair and replace any faulty work discovered prior to one year after acceptance of the basin. Acting on the results of an investigation made for the Walsh company by Sanford Thompson, Wilbur J. Watson and J. M. Armstrong, who disagreed with most of the conclusions reached by the city's experts, the company refused. Thereupon the city called for bids and let a contract to the John F. Casey Co. of Pittsburgh (*Engineering News*, Nov. 23, 1916, p. 1009, and Dec. 14, 1916, p. 1150). The cost of this work as carried out amounted to $326,277.35. The original basin had been contracted for at unit prices totaling $272,636 on the estimated quantities, but actually cost (including extras) $311,067.41.

The filter plant and reconstructed clearwater basin are now in operation, and have been operating during the past three years, in progressive proportion.

Suit was brought by the Walsh company for unpaid balance. In answer the city claimed that the contract had not been completed; that its liability was limited in any event by the available funds certified on the contract, and that the extras had not been ordered in writing; and it further entered counterclaim for the payment of liquidated damages for delay in completion (the length of this delay being not stated) and also for the *entire cost of reconstruction*, alleging that the reconstruction was necessitated by the contractor's faulty work. The defects charged included allowing excessive loam, clay and fines in the sand, and soft stones in the coarse aggregate; improper proportioning and mixture; failure to clean the surface of the concrete before placing additional concrete; failure to deposit the concrete so as to give a compact, dense and impervious concrete; failure to join the old and new concrete in such a way as to prevent cracks and leaks occurring; failure to keep the concrete moist and prevent shrinkage; failure to remove water prior to depositing concrete; failure to step off the concrete at construction joints; use of leaky and misplaced forms; failure to prevent displacement of reinforcement; general use of excessive water; pouring the columns in two or more lifts; allowing cracks to form in the dividing wall between the two sections of the basin; and failure to give personal attention to the work.

Findings of Master and Court

The findings of the special master, so far as concurred in by the court, were:

(a) The original contractor is not liable for the cost of reconstruction, but only for the cost of remedying defective work. The defective concrete found was computed as 1,922.67 cu.yd., of original value $14,431.86, but estimated to cost $56,000 to cut out and replace. As this method of repair was not chosen by the city but the basin was reconstructed instead, he is liable only for the original value.

(b) The existence of defective work does not prejudice his claim that the work was completed, and he was entitled to reasonably prompt acceptance by the city; the master fixed a date of constructive acceptance.

(c) The contractor is entitled to payment for extra work ordered (even though not in writing), but not for work due to a proper risk of the contract, such as slides, nor for extra work arising from the presence of a city railroad track not shown on the city's plan but present on the site when he bid.

(d) He is liable for liquidated damages for delay in completion, at the rate fixed in the contract, proper extensions of time being allowed for delays caused by the city, up to the date of completion fixed by the master.

On the important question whether the city is liable under the contract for an amount exceeding the moneys certified on the contract by the city's director of finance as being available for the contract, the master held that it was not liable, and that therefore the contractor could not recover the balance due and extras, but on the other hand was relieved from liquidated damages for delay, as the contract terminated when the money was exhausted and completion thus became impossible. Judge Westenhaver, however, reverses this finding, after full analysis of the law; he holds the city liable for unpaid balance and extras, and holds the contractor liable for payment of liquidated damages.

The court also holds the contractor's surety liable, in spite of minor changes in and additions to the contract, which the surety claimed had been made without his consent.

On a number of the points involved the reasoning is given below by citations from the report and the decision, as having essential bearing on proper contract administration.

Certification and Validity of Contract

Specific clauses of the city charter require that every contract, to be valid, must be endorsed by the city's director of finance with a certificate that funds are available for the purpose of the contract, stating the amount. A clause of the clearwater basin contract made the same requirement. Accordingly, the director of

finance certified on the contract that $272,636 was available, this being the total for the engineer's estimate quantities at the unit prices bid by Walsh.

The court held that, like similar provisions in the Ohio general code, the charter requirement of certification applies only to contracts paid from taxes, not from bond issues, and that the basin contract would have been valid without certification. The court further observes:

In making a contract upon a unit basis, especially one of this magnitude, it is impossible to do more than to make an approximate estimate, and this is what was done. It was expected and contemplated that these quantities might be exceeded. Likewise in a work of this character and magnitude, unforeseen conditions will arise during performance which make necessary changes and alterations in the plans in order to accomplish the main object and purpose of the contract. This also, the contract evidences, was contemplated by the parties, and provision is made therein for changing and altering the plans during performance and for extra work, the necessity for which it was expected would arise but the nature and extent of which could not be determined in advance. If the master's conclusion is sustained, the city's power to make a contract upon a unit basis would be utterly destroyed.

Obviously the proper construction of these sections whenever applicable must be one which will permit a valid contract to be made and will enable both parties to determine at the time of making it whether or not the contract is a valid one and susceptible of full performance. It is either valid at that time or it is invalid; if valid when made, it binds both parties until fully performed; it does not become invalid because of the failure to estimate correctly in advance the amount necessary to be certified.

Substantial Performance and Delayed Acceptance

In confirming the master's finding that the faulty work found does not bar the claim of substantial performance, the court says:

It is settled law that if a contractor performs in good faith, is guilty of no intentional violation of his contract but has merely deviated from the plans, or was not guilty of allowing defective materials or faulty workmanship to creep in during performance, he is entitled to recover upon the theory of substantial performance. . . . It is also settled that if a contract is substantially performed, a refusal of the engineer or architect to accept, even when such acceptance is made a condition precedent to the contractor's right to recover, is unreasonable and arbitrary, and will not bar recovery.

The master, in considering whether the delay of the director of public utilities to accept the work was justified, remarks as follows:

In the testimony of Thomas S. Farrell, director of public utilities, he stated that he had reason to refuse acceptance, but upon cross-questioning it was brought out that the reason for this feeling was not on account of defective work of the plaintiff, but because failures had occurred in other structures in the immediate vicinity built in connection with the filtration plant which made him look with distrust upon the work of the plaintiff.

Taking into consideration the meetings held between the contractor's representatives and the city, the endorsement of the work and comments upon plaintiff's claims for extra payment made by the city's engineer, the protection which the contract afforded in case defective work was found even after the making of the final estimate, the one-year period of maintenance, and the fact that the city had assumed at least a partial control of the reservoir by placing it in charge of its foreman and with its own forces made repairs upon the reservoir for defects which were not considered as the fault of the plaintiff, it would appear that the director of public utilities could and should have given the formal acceptance required under the contract, which in turn would have established the date when the final settlement for the work would have become due, subject to the terms of the contract.

Thereupon the master fixed a date about three months after completion as a constructive date of acceptance.

Contractor's Liability for Reconstruction

Opposing claims of improper design and improper construction were analyzed by the master in deciding whether the cost of rebuilding the basin should be charged to the original contractor. He states, with respect to the relative influence of defective workmanship and defective design:

Testimony indicates that some defective concrete was placed by plaintiff, and that also other defects existed in the structure which it was not proven were due to workmanship or materials furnished by the plaintiff.

The reservoir for which plaintiff held contract was of a type requiring a firm, unyielding foundation so that any unequal settlement could be prevented. Any unequal settlement would have a tendency to open up the concrete at construction joints and form cracks at other locations in the structure depending upon the amount and extent of such unequal settlement. . . . The structure was evidently designed upon the assumption that a suitable soil was to be encountered for the foundation. A different condition seems to have developed.

After mentioning the slides and upheavals, the formation of settlement cracks in the basin structure, outward tipping of the north basin wall, flexure cracking of the columns, and the like, he finds that:

All of these conditions are evidence of the instability of the foundation soil, such as might be expected at the location, such as occupied by the reservoir, where a quicksandy soil was encountered at a depth of 8 or 9 ft. below the level of Lake Erie, and only a short distance removed from the old river bed.

Testimony seemed plainly conclusive that many defects in the structure which it was contended required correction were incidental to the use of concrete or to the design, and at all events were due to other causes than workmanship and material furnished by the plaintiff.

Passing upon the sufficiency of the soil and its preparation for assuming its load in connection with a structure such as this reservoir, was certainly an engineering matter and an obligation which the engineer was bound to assume. To claim liability upon the part of the contractor for failure due to faulty bottom conditions, inducing settlement cracks, seems entirely without justification, as the design of the structure should have been such as to make them impossible. . . . To have expended $328,000 in making repairs to a structure costing in the neighborhood of $300,000, the defective work of which was confined to a part which involved a sum less than $60,000, seems quite inconsistent on the face of it and difficult of justification.

The repair work of the city did not consist of a replacement of defective work, so that it will never be possible to know the exact extent of the defects, nor will the cost of replacing it ever be determined. It covered any weakness or defects which the unacceptable concrete presented, but it did much more, as it largely strengthened the structure, enabling it to overcome the danger of a yielding foundation which might have caused the failure of the original structure. It thereby gave the city much more than it would have had even had all the concrete in the original structure been perfect.

The court reaches the same conclusion, and dismisses the city's objections thus:

The site was selected by the city. The plans and specifications were designed and prepared by the city. The entire design of the reservoir was prepared by the city. The contractor was bound to furnish materials and perform labor only in constructing a reservoir of that design and upon that site, without any power to modify the design or

plans to meet unexpected conditions. . . . The city or its officials could make changes, if any were deemed necessary to correct the faults of the design, but the contractor was not at liberty so to do. . . . In cases of this character it is settled law that if the contractor performs his contract according to the plans and specifications, he is not responsible for the failure of the structure because of faulty design or because the structure as designed and built will not answer the purpose for which it was intended.

The cases most strongly relied upon by the city . . . belong to an entirely different class, and relate to contracts in which there is an absolute undertaking to do a particular thing or to insure a given result, or where the loss or failure is due to accident during the progress of performance.

Liability for Defective Work

Determining the proper sum to be allowed the city for the concrete found to be defective involved the question of whether the reservoir had any value with the presence of this defective work, and the question as to what should be taken as the measure of damage. On the second point the master said:

Testimony showed that the defects in the concrete supplied by plaintiff were mainly due to excess of water in mixing. It showed that the materials used were accepted by the city's authorized representatives; it showed that the proper amount of cement specified in the specifications was used; in fact, nearly all defects were those possibly of workmanship and not materials in so far as the contractor was concerned.

. . . Had defendant let a contract to remove or replace such defective concrete to the extent required to place the reservoir in a condition, in which it could reasonably be expected to have been placed by plaintiff, then the amount of damage to the defendant might have been determined. Defendant, however, elected to use another method.

Defendant's damages therefore seem to lie wholly in determining how much of the concrete could reasonably be considered as defective under the specifications, due allowance being made in passing judgment upon the fact that the concrete was furnished as a commercial proposition and in a manner customary at the time. Defendant should not be called on to pay for concrete not of the quality specified.

Cost of Correcting Faulty Construction

The court takes up the question of reduction of value of the basin by the defective workmanship, as follows:

The measure of damages properly to be applied is that applicable to a contract which has been substantially performed but into the performance of which has entered defective materials or faulty workmanship, or departures from the plans and specifications. In cases of this character, two rules have been applied, depending somewhat upon the circumstances of each case. One is that the contractor is entitled to recover the contract price diminished by the difference between the value of the building to the owner in its defective condition, and its value if perfectly constructed. This rule is applied whenever the structure or building is useful to the owner in its defective condition and it is neither fair nor reasonably practicable to remedy the defects by the making of repairs. In other cases where there is a failure to complete the work, and such failure may reasonably be remedied by the expenditure of additional labor and materials, or where the defects are of such a character that they may be fairly and reasonably remedied by the expenditure of labor and materials, the proper rule seems to be to deduct from the contract price such sums as would be reasonably necessary to complete the work according to the contract or to make such repairs. . . . Apparently the master's conclusion is that the reservoir, except as to the collapsed portion, was worth as much with the faulty workmanship as it would have been with perfect workmanship, and that by reason of its original defective design, it was worth practically nothing in either condition, except as it served as a basis for the new and different reconstruction work provided for in the Casey contract.

The sum of $56,350, found by the master to be necessary to remedy the faulty workmanship, would undoubtedly be the true measure of the city's damages, if the structure had otherwise been adequate. . . . Moreover, it is the method of making repairs and the measure of damages provided in the contract for defects in material or workmanship, whether the necessity therefor arises before acceptance or afterward and within the guaranteed period of one year from the date of such acceptance. The difficulty in applying this rule is that the repairs were not made, for reasons for which the city alone was responsible. . . . In view of all these circumstances, the master was right in holding that the cost of repairs which were not made, and the making of which would have served no useful purpose, is not to be taken as the true measure of the city's damage. . . . If the contractor is required to surrender all compensation for that part of the work which was thus found to be defective, it would seem to me that substantial justice is done.

The decision reached is that the Walsh Construction Co. is entitled to recover unpaid balance and properly ordered extras, amounting to $38,879.21, and the city is entitled to recover liquidated damages, $5,950, value of defective concrete, $14,635.68, and value of the collapsed section, $346.49.

Protection for Reinforced Concrete Against Electrolysis

Abstract of subcommittee report, Committee on Electricity, American Railway Engineering Association.

A WATERPROOF SHELL protecting the concrete structure is the most plausible form of protection of reinforced concrete against electrolysis because the arrangement not only protects the reinforcing bars from moisture and later oxidation but also protects the concrete surrounding the rods from abrasion and, eventually, exposure of the iron. Last year it was suggested that the following methods be considered: (1) Use of copper plated reinforcing bars; (2) Introduction of reinforcing bars made of copper alloy; (3) Reinforcing bars surrounded by rough insulating enamel impervious to salt water and moisture; (4) Waterproof plastic layer of material with petroleum asphalt base, or some established waterproofing material free from electrolytes, surrounding base of concrete.

Further studies have led to the conclusion that the first three methods proposed are not practical because of high cost.

The fourth method is recommended, but attention is called to the necessity of using the proper waterproofing material on the inside of the protecting shell. The waterproofing pitch should remain flexible for an indefinite time; should have a melting point in the neighborhood of 200 deg. F., and be elastic in stretch at least ½ in. at a temperature below freezing and have approximately an inch stretch at 60 deg. F. If the pull is gradually applied, the stretch should be approximately 6 to 7 in. at 60 deg. It is rather a surprising fact that such waterproofing material has been manufactured for twelve or fifteen years but in general use only for roofing material and in pavements. It is made by distillation of an asphalt base and oxidized by blowing with air, the latter process giving the material the stretching quality.

Asphaltic petroleum pitch is soluble in gasoline, which is likely to be present in city sewerage, but recent experiments show an elastic waterproofing pitch may be made from coal tar that is insoluble in gasoline but retains all of the characteristics of the asphaltic petroleum pitch.

It is necessary to protect with waterproof pitch the top or other exposed portions of concrete structures, as well as the sides, to prevent penetration of salt air or moisture.

Indications from Motor Truck Impact Tests

U. S. Bureau of Public Roads Makes Report on Research Work With Wide Variety of Motor Trucks, Loads, Speeds and Tires

Indications toward which the results of its determination of motor truck impact forces on road surfaces point have just been made public by the U. S. Bureau of Public Roads in the form of a report by Earl B. Smith, senior assistant testing engineer in charge of the experiments, under the general direction of A. T. Goldbeck, engineer of tests, and Thomas H. McDonald, chief of the bureau. While final conclusions can not yet be drawn from the work, which has been in progress at Arlington, just outside of Washington, D. C., for two years—and is still uncompleted—the results indicate that impact value depends very largely upon tire equipment and that it is possible to operate a light-weight truck under load and speed conditions that will produce as high impact values as a heavy truck under certain conditions.

Impact values with solid rubber tires are shown to be as high as 7 times the load on one rear wheel encountering a 1-in. obstruction at a speed of 16 miles per hour. The average impact, however, is about 4 times the wheel load when solid tires are employed. With pneumatic tires, on the other hand, the average impact is not more than 1½, and the maximum not more than 1¾, times the static wheel load.

A summary of the report, the full text of which is being published by the U. S. Bureau of Public Roads, follows:

THE term "impact" in its ordinary use means the force with which a moving body strikes another body. The term is used here in this sense and its specific application is to the force resulting when a truck wheel strikes the surface of a road. This action may occur when the wheel falls from one level to another, or when it strikes an obstruction and bounds upward and finally falls to the road surface. In the second case there is an impact reaction at the time of striking the obstruction and a second impact at

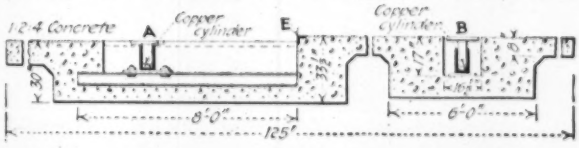


FIG. 1. SPECIAL ROAD SECTION FOR IMPACT TESTS
Truck wheel strikes plungers A (drop) or B (obstruction) compressing copper cylinder.

the time of striking the road. The impact will vary in intensity with the speed of the truck. The impact considered here is only the force acting vertically or normal to the road surface. Other components will be less severe than the vertical, which is therefore the critical and controlling force.

Static loads or forces are measured as only a single factor, i.e., as weight or pressure. An impact force is the result of mechanical energy or of mass times acceleration; it is a function of weight, distance, and time. Since each force may be made to produce a deformation, we may express an impact force as equivalent to a static force which causes the same deformation. This is not, of course, entirely satisfactory; it is a permissible approximate comparison, and is only practical in its application when the load or force producing the impact is large and moving at a moderate velocity.

In employing the deformation method a ½-in. copper cylinder is placed at the bottom of a heavy cylinder under a loose but neat fitting plunger, and the impact is received on the head of the plunger. The deformation of the copper is then measured and compared with the deformations produced by static forces.

In all discussions of impact forces from motor trucks it is the effect at one rear wheel only which will be considered, since here the force of impact is greatest and it is at this point that the controlling factors have the greatest influence.

Experimental Results

For the purposes of the tests which have been made a special runway of concrete was constructed, as shown in Fig. 1. This runway is so designed that the height of the head of the plunger *B* is flush with the road surface. The "obstruction" tests are made at this place by bolting to the plunger head a strip of hardwood 4 in. wide and 16 in. long, using thicknesses of ¼, ½, ¾, 1, 2, 3, and in the case of pneumatic tires, 4 in.

The "drop" tests are made at the drop-off edge *E*, the plunger beyond and in the lower pit being so placed that the plunger head *A* may be elevated to give "drop" distances varying from 0 to 3 in. The plunger may also be moved away from the edge *E* any distance to receive the blow of the wheel as it jumps varying distances, depending upon the speed of the truck. A ½-in. copper cylinder, heretofore mentioned, is placed under each plunger as shown. By this preparation it is easy to secure the data from both types of tests during one run or passage of the truck.

The impact of only the left rear wheel is measured. A bridge is placed over each plunger head to protect it from the front wheel. As this wheel passes, the bridge is jerked out leaving the plunger head clear to receive the impact of the rear wheel. In the case of the obstruction test, the right wheels (front and rear) do not strike the obstruction. But in the case of the drop test both right and left wheels are caused to drop the same amount.

Truck speeds are determined with a stop watch by noting the time to pass two points which are 30 ft. apart. These speed determinations are accurate to a maximum variation of 10 per cent.

The indications given by the measurements of the copper cylinders may have a maximum variation of about 5 per cent. The introduction of a copper cylinder as a means for measuring the impact also introduces a cushioning effect which in turn serves to reduce the impact value. A few experiments have been conducted to determine approximately what this cushioning effect may be.

The impact values shown on the charts as ordinates are the actual static indications from the ½-in. copper cylinders as measured immediately after the test. This is known as the static equivalent, and is plotted as such in all of the charts without corrections of any kind. It is realized that these values are only comparative and are not actual impact values. To arrive at a more nearly actual impact indication, or maximum force value, it will be necessary to correct these static equivalent values by increasing each by the cushioning factor and multiplying by some factor to allow for the fact that the copper cylinder measures the average impact and not the maximum. The value of this last factor may be from 1.5 to 2, depending upon the equation of the stress-strain diagram. No corrections of this kind have been made in any of the data or charts presented.

The tests are planned to show the influence of only the important factors upon the value of the impact force. The speed of the truck is considered to be one of the most important factors. It is most spoken of in connection with the operation of a truck, and the one factor against which are aimed more traffic rules and laws than any other. The determination of its effect upon the value of the impact force is very important. For this reason speed values, in miles per hour, have been made the independent variable in most of the tests.

Trucks of different weights and capacities have been used in the tests. Some of the trucks have comparatively heavy unsprung parts and some have light unsprung parts. The effect of this factor was especially studied in the tests upon two trucks of the same capacity under different loadings and speeds, each truck being equipped with the same set of tires.

Tire equipment was considered to be a very important factor. As far as possible, each truck was tested, at different speeds and loadings, with several kinds and conditions of tires.

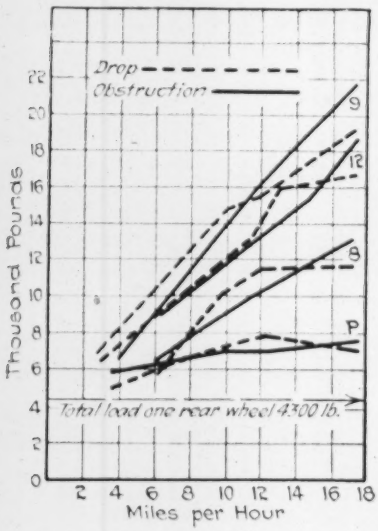


FIG. 2. COMPARISON OF TIRES, 2-TON TRUCK, UNSPRUNG WEIGHT, 1,000 LB.

P—Pneumatic, 130 lb. air, 49 x 9-in. cord, new, deflection, 1 in.
8—Cushion, 36 x 5 x 3-in., dual, defl. 0.58 in.
12—Solid, 36 x 8 x 2½-in., one, defl., 0.30 in.
9—Solid, 36 x 4 x 2 in., dual, defl., 0.28 in.

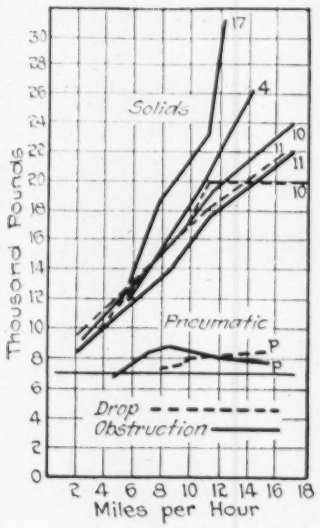


FIG. 3. COMPARISON OF TIRES, 3½-TON TRUCK, LOAD 4½ TONS. UNSPRUNG WEIGHT, 1,300 LB.

Load, one rear wheel; 7,000 lb. Obstruction and drop, 2 in.
P—Pneumatic, one, 42 x 9-in., new, air 142 lb., defl. 1.1 in.
4—Dual, 36 x 5 x 1⅛-in. worn, defl., .2 in.
10—Dual, 36 x 5 x 2½-in., new, defl. 0.32 in.
11—One, 36 x 10 x 2½-in., new, defl., 0.32 in.
17—One, 36 x 10 x ½-in., worn, defl., .09 in.

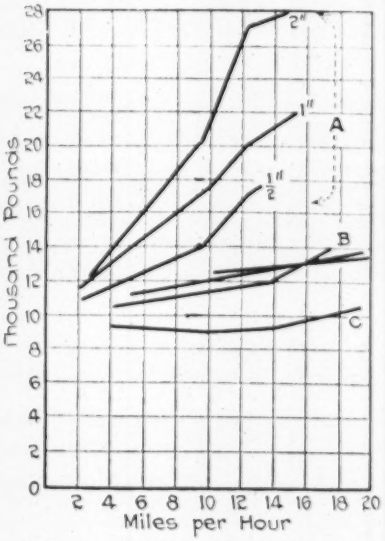


FIG. 4. SOLID AND PNEUMATIC TIRES ON TRUCKS OF APPROXIMATELY SAME WEIGHT

A—Solid, 40 x 6-in. dual, 5½-ton truck, load 7.5 tons, one rear wheel load 9,625 lb., obstructions 2, 1 and ½ in.
B—Pneumatic, 48 x 12-in., special 5-ton truck, load 7.15 tons, one rear wheel load 10,500 lb., obstruction 4 in.
C—Same as B with 1-in. obstruction.

To get a definite idea of the effect of the height of fall, or of the height of an obstruction or irregularity in a road surface, this factor was used as one of the variables in most of the tests.

What Charts Show

The experimental results obtained during the conduct of these tests are plotted in 133 charts. After securing and studying results many interesting and important comparisons present themselves. No attempts will be made at this time to analyze all possible comparisons between the results shown on the charts. A few of the important features and indications are shown in Figs. 2 to 7, inclusive.

Fig. 2 shows an important comparison of the effect of the tire equipment upon the value of the impact. The truck used in this comparison was of 2-ton capacity, carrying a 2-ton load. Four different tires were used and a complete series of tests was run with each, using in each case the speed as the independent variable. The comparison is shown with both the drop and the obstruction test. To draw attention to the obstruction test only, it is noticed that the impact value (the ordinate) shows a considerable change with only a slight change in the tire deflection. The impact value,

with all conditions the same except the tire, is the greatest for the solid rubber tires and the smallest for the pneumatic tire, the cushion tire giving an intermediate value. At low speed the difference is not so great. At a speed of 17½ miles per hour the pneumatic tire gives an impact value of only 1.75 times the rear wheel pressure on the road surface, the cushion tire over 3 times, and the solids 4.3 to 5.1 times. In this particular case, the cushion tire gives an impact value of 63 per cent of the solid tire average, and the pneumatic only 36 per cent. It should also be noticed that for the pneumatic tire the impact value increases only very slightly with the increase of speed.

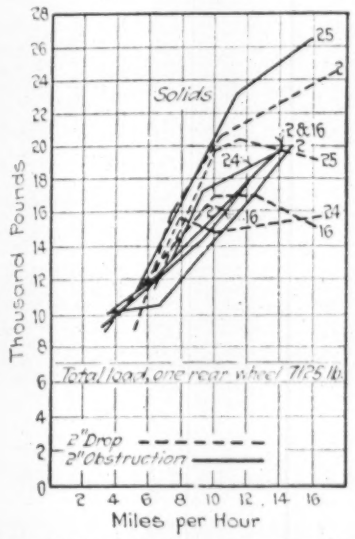


FIG. 5. COMPARISON OF SOLID TIRES, 5-TON TRUCK, LOAD 5 TONS, UNSPRUNG WEIGHT 1,300 LB.
2—Dual, 40 x 6 x 2-in., old, defl., 0.23 in.
16—One, 40 x 10 x 2½-in., new, defl., 0.28 in.
24—Dual, 40 x 6 x 2¾-in., old, defl., 0.33 in.
25—Dual, 40 x 6 x 1¾-in., old, defl., 0.15 in.

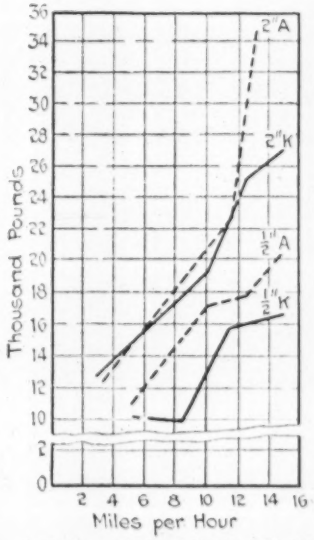


FIG. 6. COMPARISON OF TRUCKS VS. SPEEDS
Drops 2 and ½ in., good dual solid tire, 40 x 6 in.
A—Wt. (sprung) 8,150 lb.; wt. (unsprung) 1,950 lb.
K—Wt. (sprung) 8,800 lb.; wt. (unsprung) 1,300 lb.

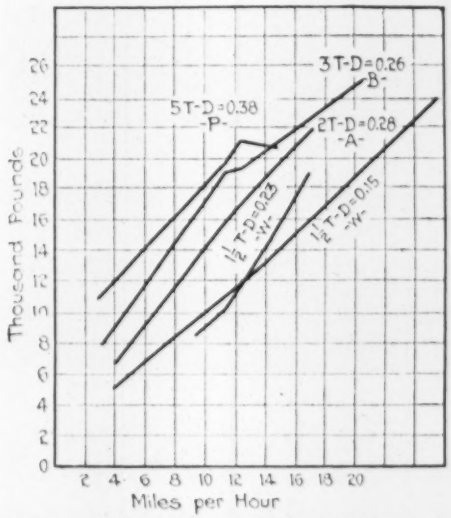


FIG. 7. COMPARISON OF TRUCKS OF DIFFERENT CAPACITIES; TIRE DEFLECTIONS INDICATED; ALL OBSTRUCTIONS 2 IN.

Fig. 3 shows also a comparison of the effect of tire equipment. The truck used in this case was of 3½-ton capacity, loaded with 4½ tons, the unsprung weight being equal to 1,300 lb. The total load at one rear wheel was 7,000 lb. Here, it should be noticed that with pneumatic tire equipment the impact force was only 15 per cent greater than the actual wheel load. The four different solid tires which were used in this series show very clearly the effect of the condition of the tire. Tire No. 17 gave some very high impact values even at 12 miles per hour. This tire was badly worn, having a thickness of only ¼ in. above the rim. The other solid tires gave impact values somewhat in proportion to their deflection or condition. The results as shown by tires Nos. 10 and 11 indicate the usual impact values that may be expected with good solid tire equipment, while the results shown by the use of tires Nos. 4 and 17 show the increase or extreme values that may be expected from the same truck when the tires are in a badly worn condition.

Fig. 4 is also a comparison between the effects of solid and pneumatic tires. The truck used in this case was of 5½-ton capacity, loaded with 7½ tons. This figure is intended to show the very great cushioning effect of pneumatic tires in comparison with solid tires. In this case a 4-in. obstruction was used during the test with the pneumatic tires, and the resulting effect was very much less than when using a solid tire on ½-in., or 1-in., or 2-in. obstruction. The figure also shows the effect of the air pressure in the pneumatic tires upon the value of the impact force.

Fig. 5 shows also a comparison of tires. This shows that in general the magnitude of the impact force is dependent upon the condition and deflection of the tire. It shows, as did Fig. 3, the wide variation in impact values that may be expected from the same truck equipped with tires of different conditions.

Fig. 6 shows a comparison between trucks. Two 5½-ton trucks were used in this case and each was loaded so that the total rear wheel load was the same in each case. Truck A had an unsprung weight of 1,950 lb. and truck K had an unsprung weight of 1,300 lb. Both trucks were equipped with the same set of tires. The purpose of this comparison is to show the effect of unsprung weight upon the impact value. It is very clear that the truck having the lighter unsprung weight produced the smaller impact values under the conditions of this test.

The purpose of Fig. 7 is to show the possible impact values which may be obtained by using trucks of different capacities. It is clear that the light truck, *W*, if run at a sufficient speed, may give impact values as high as a heavy truck, when run at the ordinary truck speeds of 8 to 10 miles per hour. These impact values were all obtained from a 2-in. obstruction. This figure shows that it cannot be said that a heavy truck always gives the highest impact values, without stating several qualifying conditions, especially the condition of speed and of tire equipment. This statement refers to impacts only. It should be noted in particular that a light truck running at high speed will produce large impacts only occasionally and never very heavy load pressures; while a heavy truck will produce in addition to impacts a continuous heavy pressure on the road surface.

The results presented here must not be considered as final. The investigation has not been completed, and will continue under different conditions for some time. It is not the intention in this paper to state final conclusions or to deduce final laws and comparisons. It is, however, thought desirable to state briefly some of the indications toward which these results may point:

The impact value depends very largely upon the tire equipment. The condition of the tire—that is, whether it is new or badly worn—determines the amount of cushioning effect it may offer. The deflection of the tire depends upon its depth and quality, and any condition of the tire which adds to its deflection will, of course, serve to reduce the impact. The actual shape and construction of the tire seem to have considerable influence upon its cushioning effect. No account, however, has been taken of the power-consuming factor of any particular type or shape of tire.

So far as they have been tested, cushion tires seem to offer a decided advantage in reducing the impact. In this connection it should be stated that the name "cushion" on a tire does not necessarily make it such a tire. Some definitions and deflection requirements should be adopted for the classification of tires. Certainly a tire which does not have at least a deflection value of 40 per cent to 50 per cent of the deflection of a pneumatic tire under the same capacity load should not be classed as a cushion tire.

Pneumatic tires, as might be expected, show a very great influence in reducing impact values, and the impact produced with such equipment seems to increase only very slightly with the speed.

Considering the effect only upon the impact, the width of the tires, or the load per inch of tire width has very little controlling influence. The deflection of the tire is the main factor and this is controlled only slightly by its width. A decrease in tire width increases the load per square inch of tire, which in turn causes a slightly greater tire deflection. This, then, should tend to slightly decrease the impact. It will thus be seen that a large tire width does not tend to decrease the impact, but rather to increase it. It is a fact that a very wide but thin solid tire will give much higher impact forces than a narrow thick one. In so far as the unit load on the road surface is concerned, this must be considered from an entirely different viewpoint.

The speed of the truck has an important influence upon the value of the impact force, but it is a somewhat complex relation. It is not a simple arithmetical ratio, nor can it be expressed simply as a certain power of the speed ratio. When striking an obstruction or irregularity, the curve showing the impact values in relation to speed is approximately a straight line. But the equation of this curve depends upon the characteristics of the truck, the height of the obstruction, and the deflection of the tire, as well as the speed. For approximate comparisons it may be stated that the impact increases with the increase of speed:

10 to 100 per cent for solid tires;
10 to 75 per cent for cushion tires;
and 0 to 10 per cent for pneumatic tires.

An average of any of these limiting percentages must not be used, as the performance of any truck is too variable, and the relation of the other controlling factors cannot be predicted.

When dropping from one level to another the speed affects the impact value somewhat according to the percentage variations, given in the preceding paragraph, up to the point of a critical speed of 9 to 12 miles per hour. Beyond the point of critical speed at which the wheel falls freely there should be no increase in impact value.

Although heavy unsprung weights may give higher impact values than lighter unsprung weights, it can not be said that this is the major controlling factor. With all other conditions remaining constant this may be true. But other controlling factors, such as tire equipment, spring stiffness, load carried, and speed, may have a greater influence and overcome any difference due to the unsprung weights.

It is easily possible to so operate a light-weight truck under certain load and speed conditions that it will produce as high impact values as a heavy truck under certain conditions. Much remains to be learned, however, as to the relative destructive effects of light-weight, fast-running vehicles, and slow, heavy trucks.

The impact values as shown on the accompanying charts may be as high as 7 times the load at one rear wheel for a solid tire over a 1-in. obstruction at 16 miles per hour; an average value being about 4 times. For pneumatic tires the maximum impact value is probably not more than 1¾ times rear wheel load, and the average not more than 1¼ times.

Mr. Smith's report concludes with an acknowledgment to J. T. Pauls for his painstaking and thorough effort in conducting the field tests, and for his aid in preparing and plotting the charts; and to C. A. Hogentogler for helping to secure and analyze the data. This investigation is under the general direction of Thomas H. MacDonald, chief of the Bureau of Public Roads, and A. T. Goldbeck, engineer of tests.

More About Marshall Irrigation Plan

That the U. S. Geological Survey is in no sense a sponsor for the plan for "All-California Irrigation" mentioned in the issue of Feb. 10, pp. 273 and 277, as being promoted by R. B. Marshall, is shown by the following paragraph from a letter sent to the California Press by George Otis Smith, director of the Survey:

"Neither the Surveyor nor any member of its staff has initiated, given serious consideration to, or endorsed the Marshall plan, either as a whole or in any of its details, nor has the Survey's work been directed toward a solution of the many far-reaching problems which it involves. The only information collected by the Survey that is applicable to the solution of these problems is that which relates to the physical factors of topography, water supply, and geology. Of these factors, Colonel Marshall, during his connection with the Survey, was officially concerned only with topography. Furthermore, the information has been collected with view to its general use as a basis for the beneficial development of the resources of the State and not with specific relation to the Marshall or any other particuler plan. Of the tremendous financial, legal, constructional, and human factors involved in such a project neither the Survey nor any of its members has made an official study. Neither Colonel Marshall's former connection with the Geological Survey nor his use of data collected by that organization should be regarded as lending the Survey's authority to his plan or as indicating its practicability."

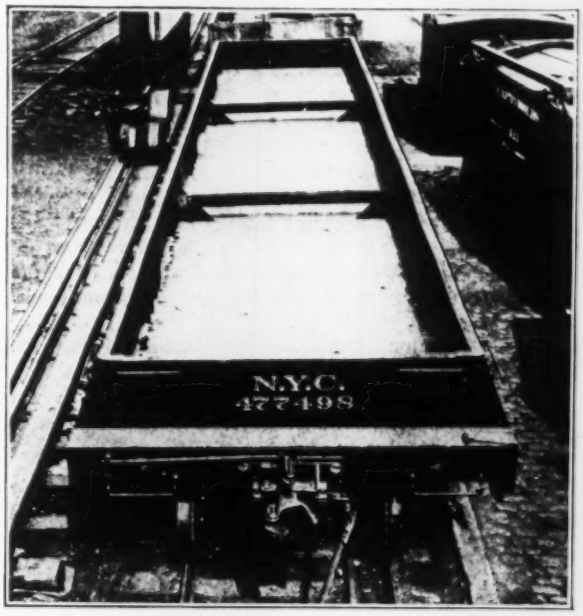
New Container Car for Store-Door Delivery Freight Service

Operated by New York Central Between Chicago and Cleveland in Special L. C. L. Service—Existing Cranes Handle Bodies

A NEW specially designed truck-body-container car of 50 ft. length for less-than-carload store-door delivery service has been put in operation by the New York Central R.R. between Chicago and Cleveland. It carries two containers of 7,000 lb. capacity each and two of 3,500 lb. capacity, specially designed to fit in with standard motor-truck equipment and for easy handling between car and truck by existing cranes during inauguration of the service. The purpose of the new freight service is to advance deliveries, to eliminate rehandling at stations and loss and damage in transit and at stations.

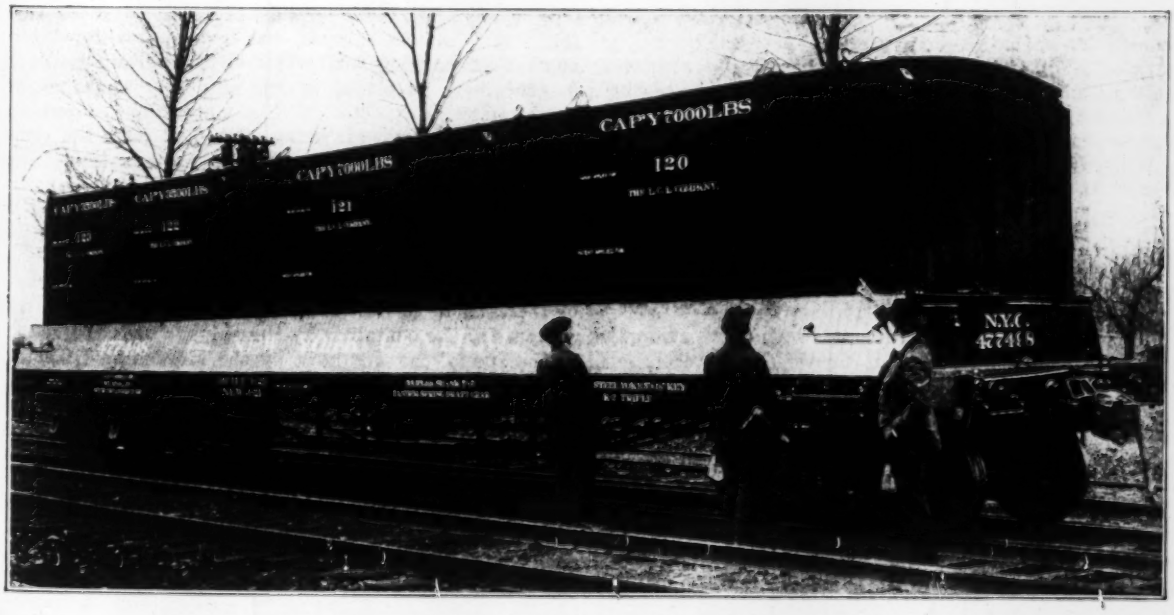
The railroad already had put in service a special steel car for express business with nine containers. The new car has been designed for less-than- carload freight service and it is stated in the published tariff that the car will be used between the railroad company's 12th St. station at Chicago and the East 38th St. station as Cleveland, "in conducting certain tests to develop the transportation advantage to be derived from handling less-than-carload merchandise freight in containers."

The frame of the container car is similar to the low-side gondola car. It is 50 ft. long—or 9 ft. longer than the longest New York Central box car—in order to take maximum loads in bodies that would best fit in with motor-truck equipment. With a car length of 40 ft. it would be possible to carry two containers of size to fit a five-ton truck chassis. The frame of the car is of steel, designed to correspond with the width of the containers, which cannot be as wide as the standard car floor because of state highway laws regulating overall width of motor trucks. To prevent the use of the floor space along the sides of the containers as a running board an oak filler with slanting sides is used. The containers fit into the body of the car, which is 22 in. high, and are held by sectional guides of ¼-in. pressed steel relatively located on the sides of the car to receive shoes at each corner of the containers, on their lengthwise sides, to hold them securely. The pressed steel guide shoes on the containers are 10 in. high and 4 in. wide, extending 1½ in. from the face of the body. Dividing the car into three sections are four



CAR DIVIDED INTO THREE SECTIONS HOLDS CONTAINERS SECURED BY SIDE GUIDES

Pressed steel guides located to receive shoes at each corner on long side of container. Slanting sides of car body 22 in. high prevent use of car floor at sides as running board.



NEW CONTAINER CAR FOR LESS-THAN-CARLOAD STORE-DOOR DELIVERY SERVICE

Specially built to transport interchangeable container-truck-bodies of 7,000 lb. and 3,500 lb. capacity

diagonal steel plates extending from the car underframe to the steel sides. To each diagonal plate the ends of two steel straps are riveted, dividing the car into three distinct sections. The outside width of the containers is 7 ft. 11 in., including depth of shoes, and the dimension between the sides is 8 ft., giving a play of only ½ in. on each side.

The containers are interchangeable, except that the two smaller ones must occupy a one-third section of the car, the same space occupied by one of the larger containers. The load may consist of six small or three large containers or four small containers and one large. The containers open at one end by double swinging doors to give an opening 6 ft. 8 in. high and 3 ft. 7 in. wide. The doors are equipped with a strong locking device. To open the container it is necessary actually to raise it out of the car. Should the car run with one section empty the steel cross plates will prevent opening of the door just as the ends of the car do when completely loaded. The dimensions of the containers are as follows:

GANTRY CRANE AT CLEVELAND TEAM TRACKS HANDLES CONTAINER-BODY BETWEEN CAR AND TRUCK

Crane carries special cradle with eyelets fitting hooks on container to relieve it of strain from close rigging to the crane hook

LARGE CONTAINER

Outside length, 14 ft. 8½ in. Outside width, 7 ft. 7 in. Outside height, 7 ft. 7⅞ in. Inside length, 14 ft. 2 in. Inside width, 7 ft. 1½ in. Inside height, 7 ft. 7⅜ in.

SMALL CONTAINER

Outside length, 7 ft. ½ in. Outside width, 7 ft. 7 in. Outside height, 7 ft. 7⅞ in. Inside length, 6 ft. 7 in. Inside width, 7 ft. 1½ in. Inside height, 7 ft. 7⅜ in.

The containers have steel frames, with floors strongly reinforced. The sides are of fir wood. At each top corner there is a heavy hook attached to the steel frame to rig them for handling between car and truck. A special "cradle" of length and width similar to the larger container is provided as an accessory to cranes at transfers to reduce stress on container frames from close rigging. The cradle carries eyelets to fit hooks at each corner of the larger containers.

Existing team tracks and existing gantry crane equipment for heavy service are being used as transfer points at Cleveland and Chicago for the handling of the containers between car and truck. It is expected, however, that the service will prove sufficiently successful to warrant expansion that will require some revision of terminal transfer facilities and minor revision of layout. Inbound and outbound transfers would be established for the less-than-carload store-door delivery service, equipped with special superstructures to carry cranes more especially adapted to the service than the existing cranes that are now being used but which were built for heavier service, although satisfactory to effect transfers in operation on a small scale.

The first service trip was made March 19, 1921. The car left Chicago loaded with a shipment of groceries from Reid, Murdoch & Co. for its Cleveland branch. Eight minutes were required for placing one of the large empty containers on the waiting motor-truck chassis bound for the shipping dock of the wholesale grocers, where loading of the container was accomplished in about 33 min. The loaded container was rigged, hoisted and placed on the car in 5½ min. and the second empty container was set out of the car onto the truck chassis in 3½ min. After loading it was replaced in the car in 6 min. At Cleveland, where the car arrived at the Wasson St. crane track of the New York Central, unloading of the first container to truck took 7½ min. Replacing to car after return from consignee's plant required 6 min. To remove the second container consumed but 2½ min. It was seen that much less time was required for removal when the crane was close to the container, the first operation consuming most of the time. It is stated that every article shipped was received without any damage or marking whatever and in the same position in containers as placed by the shipper. The time of operation, it is expected, will be materially reduced.

The special service is being offered at rates the same as those already existing for the various kinds and classes of l.c.l. freight, no charge being made for the weight of the containers. For the purpose of test, says the published tariff, shippers and consignees will be allowed the use of containers for loading and unloading at factories, warehouses, etc., the expense of drayage or trucking to be borne by the railroad and that of the contents of the container by the shipper or consignee.

The special car was built by the Merchants Dispatch Transportation Co. at its East Rochester shops from the plans of the New York Central. The service is operated by the L. C. L. Co., a subsidiary organization.

Colors for Highway Routes

The standard colors for route designations now in use in New York, Connecticut, Massachusetts and other Eastern States were adopted by the New Jersey Highway Commission recently. Blue bands are to be painted on poles along north and south routes; red bands for east and west routes; and yellow bands for diagonal routes, such as northeast, southwest, etc.

Revised Constitution for Am. Soc. C. E.

New Method Proposed for Electing Officers; By-Laws Provided To Cover Certain Provisions Now in Constitution

IN CONFORMITY with the announcement made at the annual meeting in January, the committee on referred amendments of the American Society of Civil Engineers has reported to the board of direction the revised form of constitution and the document is now in the hands of the members. It will be discussed at the annual convention at Houston April 27.

The outstanding features of the revision are a new method of electing officers and the splitting of the present constitution into two documents, a constitution and a set of by-laws. A primary system, by ballot, is proposed for electing officers, while the object of putting certain provisions in the form of by-laws is to make them easier of amendment.

In its report the committee explains that its object was to harmonize in as far as practicable the suggestions regarding revision that have been made. Special attention was given to the nomination and election of officers, and to the subdivision of the society for that purpose. The committee states that it made as few changes as possible, and only those that were consistent with the attainment of the purpose in mind. It believes that the proposed revision is one that will give the society "(1) a form of government that would be more directly representative of the membership body as a whole; (2) a method of nomination and election of officers that would bring the entire membership into participation and avoid as far as possible the probability of preponderating influence of any locality."

New By-Laws

Believing that the following provisions of the present constitution are of such a nature that it should be possible to change them without going through the difficult procedure required for constitutional amendment, the committee has thrown them into the form of by-laws:

Election of members (but not qualifications of members); payment of dues (but not the dues themselves); management, being a specific description of the duties of the board of direction and of the officers; committees, being a statement of their duties and the rules governing the activities of special committees; student chapters (an entirely new section, not existing in the present constitution); meetings, being an order of business for conducting annual meetings and regular business meetings.

Under the proposed revision to amend the constitution would, as now, require a two-thirds vote. The by-laws, however, could be amended by a two-thirds vote of the board of direction, provided there be thirty days' notice in writing before the meeting at which the proposed action is to be taken.

Officers and Their Election

By the proposed revision of the constitution the number of members of the board of direction would be reduced from thirty, as at present, to twenty-five, a president, four vice-presidents, eighteen directors, and two past presidents. The secretary, the treasurer, and three past presidents would be removed from the board. The elimination of the treasurer is proposed in the interest of equality of representation of the different geographical districts, it being felt that the treasurer probably would be, for reasons of efficiency, a resident of District No. 1.

A new method of determining the distribution of directors is proposed. Instead of being determined as now, by constitutional provision as to the number from each district, the number would vary from year to year in accordance with the number of members in each district. At the beginning of every year the total number of members would be divided by eighteen (the number of directors). The quotient would be the approximate number of corporate members for which there would be one director. It is provided, however, that no district shall be without at least one director, and if the method furnishes more than eighteen directors the board shall determine "in accordance with district membership as nearly as practicable" in which district the representation shall be reduced." The board would each year review the boundaries of the existing districts and change them if necessary. For the purpose of electing vice-presidents the board would group the districts into four zones, and one vice-president would be elected to represent each zone.

For the nomination of candidates for office the revision proposes two letter-ballot primaries, to be conducted after the order of the present method of balloting for officers. Suitable blank forms would be sent out not later than April 1 and every corporate member would be expected to submit the name of a nominee for the office of president, for the vice-presidency for his zone, and for the directorship or directorships in his district. These ballots would be canvassed on one of the first three days in June.

Not later than June 15 statement of the results of the first ballot would be mailed to each corporate member, together with a request for a second ballot. Nominees receiving less than 5 per cent of the total votes cast on the first ballot would be ineligible for the second ballot. The second ballot would be canvassed on Aug. 15, 16 or 17, and the candidates receiving the greatest number of votes for the respective offices would be designated as the "official nominees" for such offices.

Nominations by declaration might be made by petition of twenty-five corporate members "resident within the district or zone to which the office is attached."

Ballots for the actual election would go out thirty days before the annual meeting and would contain both the official nominations and the nominations by declaration. The vote would be canvassed on the first day of the annual meeting, as at present.

Other Changes

The following changes and additions are also made:

The title "Associate" is changed to "Affiliate."

Under qualifications for membership the following sentence is added, "Responsible charge in engineering teaching may be construed as responsible charge of work as required by the constitution."

The authorization of student chapters is inserted in the constitution.

No change is made in the method of disciplining members, but the committee suggests that this procedure needs revision at an early date.

An executive committee, such as has existed for the past several years without express constitutional authority, is provided for.

An article is introduced recognizing local sections, which are not provided for in the present constitution. In this section is a provision that the board of direction may annually appropriate from the funds of the society for the use of the section a sum not to exceed $3 per member of the section.

In the proposed by-laws the functions of the present finance committee would be taken over by the new executive committee, a public relations committee would be established, and the present elaborate provisions for the appointment of special committees would be done away with, the board of direction merely being given power from time to time to appoint such special committees as in its judgment may be necessary.

Dust Explosion at Large Chicago Grain Elevator

Foundations Disturbed—Some Cylindrical Concrete Bins Demolished—Steel and Concrete Superstructure Wrecked

ONE of the worst dust explosions on record occurred on March 19 in the large Chicago grain elevator of the Chicago & Northwest Ry. at 122nd. St. and the Calumet River. Six men were killed and four injured, about 500,000 bushels of grain were lost or damaged and the plant was badly wrecked, although the majority of the storage bins remain intact.

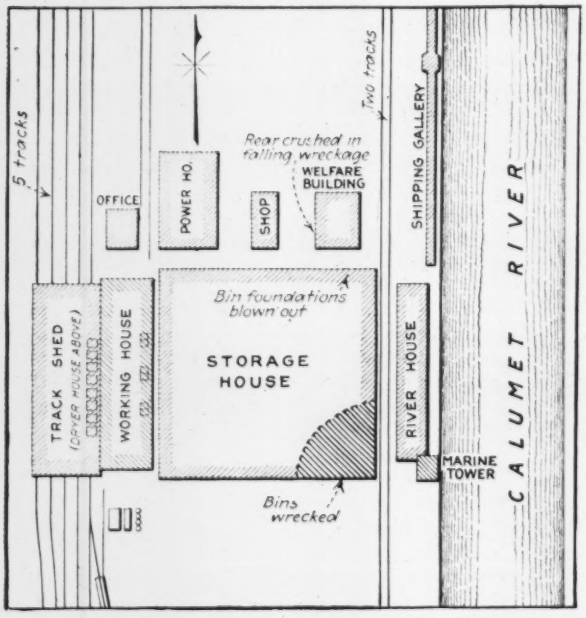


FIG. 1. PLAN OF CHICAGO GRAIN ELEVATOR WRECKED BY EXPLOSION

The general arrangement of the elevator plant is shown by the plan, Fig. 1. Over the track shed was the steel-frame drier house, in which the initial explosion occurred. Adajacent to this was the working house, with the first story of steel encased in concrete, supporting 95 concrete bins, 97 ft. high and 15 ft. in diameter, with 7-in. walls, these being surmounted by the 93-ft. steel-frame cupola, the height from ground to top of cupola being about 215 ft. Behind the working house was the storage house with 182 concrete bins 21 ft. 11 in. diameter and 104 ft. high, with 7-in. walls. Over this extended the steel frame conveyor gallery. T third unit was the river house, with a reinforced-c crete first story and 24 concrete bins similar to tho of the storage house, but 95 ft. high. Above this w a steel-frame cupola, the total height of this buildi being 194 ft. At one corner was the marine tower, 1 ft. high.

Upper Works of Gunite

Light curtain walls of "gunite" concrete on wire mes were used for the steel-frame cupolas, conveyor galler drier house and marine tower, as described in *Engineering News-Record*, April 25, 1918, p. 819. This ligh construction was adopted partly with a view t minimizing the effects of explosion, which is a hazard at all grain elevators. These walls were blown ou almost completely, as shown by the accompanying photographs, especially Fig. 2, which is a view of the fron of the working house and cupola. Much of the steel framing left in the cupolas is twisted and distorted but parts of it probably can be used in reconstruction. With heavier walls the damage to the steel work probably would have been greater. At the base of the working house is shown the wreckage of the drier house and car shed. Some of the bin foundations on the north side of the structure were damaged.

About fifteen bins at the southeast corner of the storage house were wrecked, and about half of the bins of the river house burst. In addition, a number of the bins of the working house, storage house and river house were more or less seriously cracked and damaged. The explosion in the corner bin of the river house pushed out the base of the vertical marine tower so that the tower dropped into the river in an inclined position. Damage was done also to the bin foundations, which rest on a heavy concrete slab or mattress, some of these foundations being blown out. At some places the bin structure appears to have been lifted bodily and then dropped. Complete investigation of structural damage cannot be made until after the removal of the steel wreckage and the quantities of grain which poured out at various points.

It appears evident that a first explosion occurred in the drier house, which was destroyed completely. This shock no doubt jarred loose quantities of settled dust, the dust clouds serving to propagate the main explosion, as has been observed in many explosions and tests. The main explosion swept both over and under the structure, the upper sweep extending through the steel-frame superstructure of the cupolas and conveyor gallery. The lower sweep was under the concrete bins, the weight of which increased the intensity of its force.

Dust Collectors Were Used

A dust-collecting installation was part of the mechanical equipment of the elevator to remove the dust resulting from the handling of the grain, but there would inevitably be a considerable amount lodged throughout the plant.

Retails or close-up views are shown in four of the photographs. In Fig. 4 are shown the foundations blown out at the northeast end of the storage house, with one corner block overturned; some of the bins are burst and others show horizontal cracks. Fig. 6 is a view of the southeast corner of the storage house, where the fifteen bins were destroyed. At the right is the rear of the river house. Fig. 5 shows the northeast corner of the river house, with walls blown from under

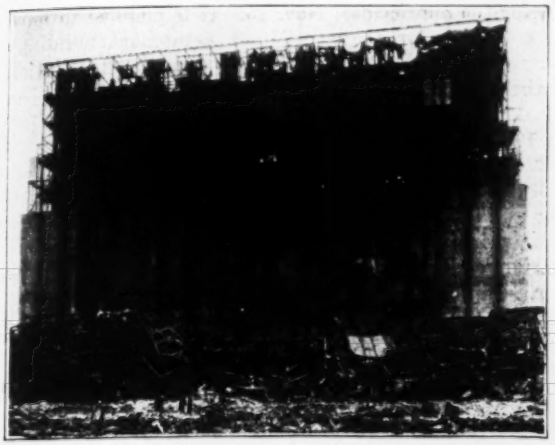


FIG. 2. WEST SIDE OF ELEVATOR AFTER EXPLOSION

FIG. 3. GRAIN BINS DEMOLISHED AND MARINE TOWER DISPLACED LATERALLY

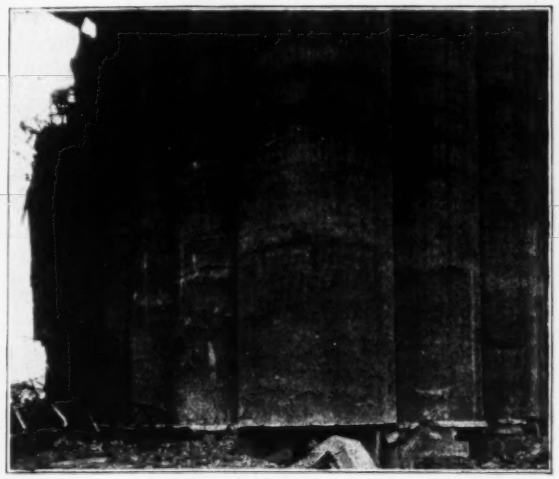


FIG. 4. FOUNDATIONS BLOWN FROM UNDER STORAGE HOUSE BINS

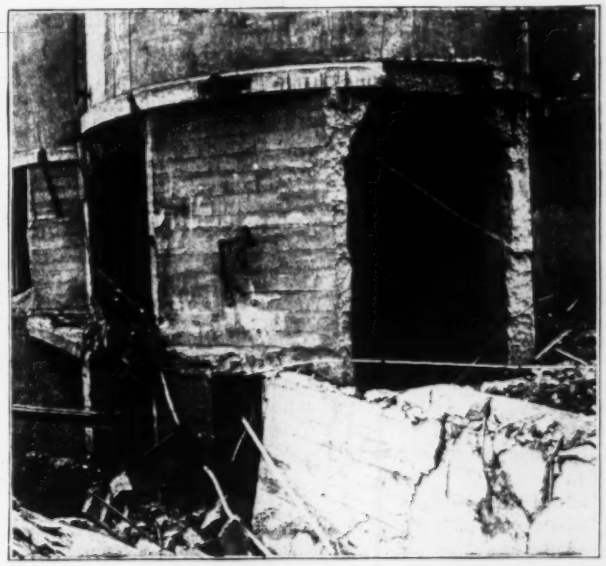


FIG. 5. WRECKAGE OF BASE AT RIVER-HOUSE BINS

FIG. 6. WHERE FIFTEEN BINS OF STORAGE HOUSE WERE BLOWN OUT

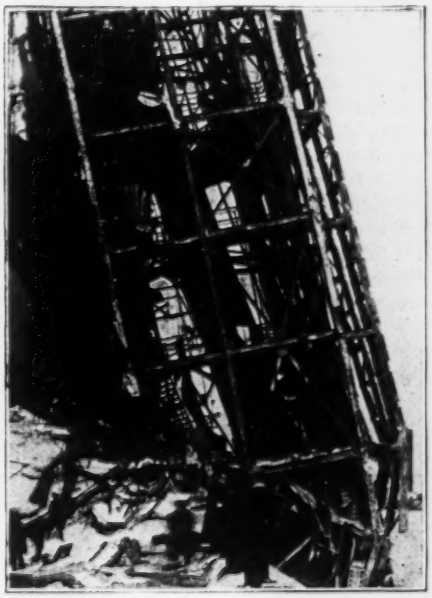


FIG. 7. WRECKED BIN AND MARINE TOWER—RIVER HOUSE

VIEWS SHOWING DAMAGE WROUGHT BY DUST EXPLOSION IN CALUMET GRAIN ELEVATOR

the bins. Fig. 7 is the southeast corner of the same house, with a blown-out bin and the marine tower pushed laterally off its foundations so that it dropped into the river.

Hudson River Vehicle Tunnel Contracts To Be Ready May 15

CONTRACTS, plans and specifications for the construction of the subaqueous portion of the Hudson River vehicular tunnel between New York and New Jersey will be ready May 15 if the schedule announced in the annual report for 1920 of the New York-New Jersey Bridge and Tunnel Commissions, made public this week, is followed. Chief Engineer Clifford M. Holland has fixed Dec. 31, 1924, as the date on which the pair of tubes will be completed, provided with the necessary ventilating equipment and ready to receive traffic.

The tunnels, consisting of twin tubes each 29 ft. in external diameter and about 8,300 ft. between portals, are estimated to cost $28,669,000. They will be built of cast-iron rings by the shield method, for it is definitely announced in Mr. Holland's report that the trench method of construction, which had been under consideration as an alternative during the past year, has been abandoned on the grounds of not being adapted to Hudson River conditions.

It is announced in the report that Lewis F. Pilcher, state architect, has been named consulting architect to the commissions and will have charge of the treatment of the tunnel approaches and portals. Traffic studies on bridges and ferries, supplementing those discussed in the commission's previous report, were made during the year. The year's operations also have included a complete system of surveys across the river to establish the tunnel alignment and base lines 5,000 and 3,400 ft. long have been laid out on the New York and Jersey sides of the river.

Tunnel Design

The preliminary design of the 29-ft. cast-iron tunnel has been investigated in detail for various conditions of loading during and after construction, and the report contains an appendix summarizing these investigations.

The design which was adopted involves the use of 14 segments and one key section. The width of each segment is 30 in., the thickness of the metal, 2 in., and the depth at the flanges, 14 in. This design has the same depth of flange and thickness of metal as that provided for in the preliminary studies of last year and differs only in details. Changes have been made to increase the strength of the joints by increasing the thickness of the metal at the four corners of the segment a maximum of ½ in. and relocating the bolts in the horizontal joints.

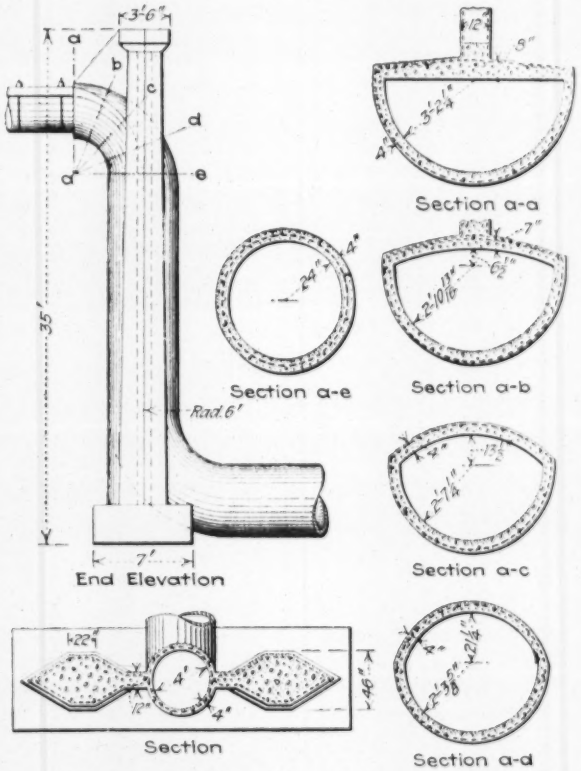
During the year progress has been made in the investigation of ventilation problems under three main divisions: (1) Amount and composition of exhaust gases from motor vehicles; (2) dilution necessary to render exhaust gases harmless; (3) method and equipment necessary for adequate ventilation. Appendices to the report contain a detailed account of this research work.

Up to the present time a contract has been let for the ventilating shafts on the New York side. According to the chief engineer's schedule, the contracts for the subaqueous tunneling work will be ready May 15 and for the approaches, Nov. 15. It is planned to have the contracts for the ventilating equipment building ready Nov. 15, 1922, and to call for the installation of the equipment not later than May 15, 1923. As stated, the tunnels should be ready for operation Dec. 31, 1924.

During the year there have been no important changes in organization. C. M. Holland continues as chief engineer and the following report directly to him: Jesse H. Snow, principal assistant engineer; Milton H. Freeman, division engineer; and Ole Singstad, designing engineer.

Inverted Siphon Terminates in Riser on Bridge Pier

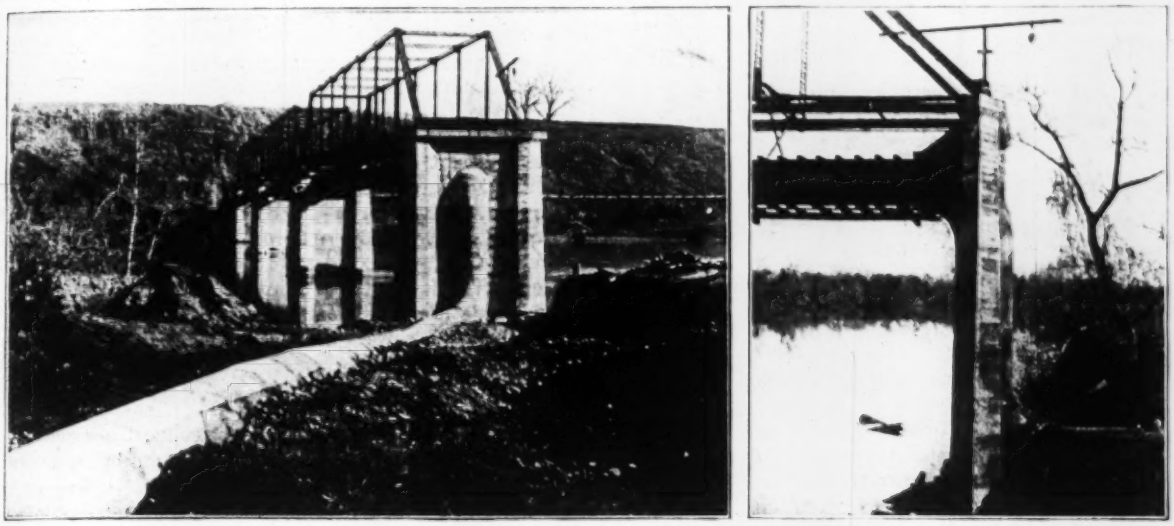
IN THE ORIGINAL scheme for serving that part of the Anderson Cottonwood Irrigation District in California which lies on the east side of the Sacramento River, the plan was to bring water across from the west bank by means of an inverted siphon consisting of 4,000 ft. of 48-in. concrete pipe and 600 ft. of 42-in.



RISER AND TRANSITION CURVE SECTIONS

cast-iron pipe. The cast-iron pipe was selected for convenience in constructing that portion of the siphon that would be under water at low levels of the stream. Because of the weight of pipe of this size, however, decision was made at the last moment to make the 600-ft. stream crossing of 36-in. pipe, adding another line later when more water was needed. On this basis construction was commenced, the concrete conduit section was completed and the iron pipe for a single 36-in. river crossing was delivered on the job.

At this juncture estimates were revised, a new engineer was retained and the work was resumed on a new basis. Decision was then made that the 36-in. pipe was



CONCRETE CONDUIT AND RISER TO THE BRIDGE FLUME

inadequate and it was decided that a method more certain and less expensive would be to terminate the concrete conduit, as already laid, in a riser from which the water could be carried across to the east bank in a flume supported by a bridge. This plan was adopted and successfully carried out.

A standard design, through-truss, steel bridge, consisting of three 133-ft. spans, was purchased for $10,000. Piers for this bridge were built to such a height that a flume hung from the bottom chords would, on 1:1,000 grade, meet the flume grade on the far side of the river. To the floor-beams of the truss a pair of 10-in., 15-lb. channels were attached by stirrups, and from these were hung 1-in. suspension rods, spaced 6 ft. apart. These rods supported parallel runs of 4 x 6-in. stringers to which a No. 120 Lennon flume was fastened in the usual manner. By this plan considerable clearance above high water is afforded, and even in the event of a flood high enough to carry away the flume, it is pointed out that the bridge, representing the major part of the investment in the crossing, would still remain.

The timber stringers were cut in 12-ft. lengths so that the joints, which were scarfed, always came at a suspension rod. Every other suspension rod was made long enough to be continued on through 4 x 8-in. corbels placed below the joints. The flume size chosen was slightly larger than that required for the 60-sec.-ft. capacity of the conduit. Thus it will be possible to operate the inverted siphon under a slight head, if desirable to increase its capacity.

The problem of design in the riser was to deliver water from the concrete pipe at flume velocity and in such way that there would be no standing wave or other disturbance of the current in pipe or flume. The riser was continued as a circular section up to the beginning of the elbow and, in the course of making the right-angle turn, the section was uniformly changed from a circle to the exact shape of the flume. The shape of the transition from the circular to the flume section was worked out by methods similar to those applied to hydraulic turbine draft tubes.

The end bridge pier, to which the riser is attached, is the same in design and construction as the other piers of the bridge. Piles were first driven in two clusters and cut off below low water. Two 6-ft. corrugated-iron pipes were then put down over the pile tops and filled with concrete. A concrete web to connect the cylinders in a single monolith was put in as low as wood forms could be conveniently used. The web is 2 ft. thick below ground and 1 ft. thick above. The riser is bonded to the web and passes through it at flume level.

The work has been completed according to designs prepared by Thomas H. Means who was employed by the Anderson cottonwood irrigation district as consulting engineer just before the change in plans was decided upon.

Educational Plan for Engineers on Great Northern

A PLAN for the education of professional engineers in railroading on the Great Northern Railway has been put into effect following a proposal made to the management by the Great Northern section of the American Association of Engineers. It was described at the recent railroad conference of the association by W. L. Lewis and briefly is as follows:

An educational bureau was established composed of the executive head of each department of the railway and three members of the A. A. E. section. Its duty is to outline and conduct the courses. There are three standing committees, program, service and progress. The first prepares the lesson sheets for study, the second conducts the details of the bureau business and the third records data regarding the student body and notes the effect on the operation of the road. Students are divided into ten sections according to departments. Sections are headed by a chief who selects lieutenants and assistants, so that classes may be organized over the entire line under the supervision of competent men. Department heads furnish the lesson sheets, which are in the students' hands two weeks prior to the class night, and are in the nature of critiques conducted outside of business hours by the author of the lesson sheets. The courses now being conducted relate (1) to railway matters, (2) accounting offices, (3) shop mathematics and drafting. A special course will soon be conducted for training engineers of the company along executive lines.

The Design of Sanitary Lateral Sewers and House Connections

By Milton J. Rurak and C. E. Keefer

Division Engineer of Sewers, Baltimore, Md. — Assistant Designing Engineer, Sewer Division, Highways Department

ONE of the first things to determine before designing lateral sewers for a district is the character of the subsoil to be encountered. This investigation may mean the simple process of reviewing old records of the kinds of materials found in the construction of water mains, gas pipes, etc., or it may involve the more expensive procedure of digging test pits and sinking borings. Frequently a sanitary sewer can be built in an alley in the rear of a row of houses much cheaper than in the front street, or vice versa, due entirely to the difference in the cost of excavation. Alleys often provide the best location, as fewer substructures are encountered, and there is less interference to traffic.

Contrary to the designs of many sanitary engineers, lateral sewers should not be built in the center of the street. They should be constructed preferably on that side that has the greater number of houses in order to make the total length of house connections as short as possible. In many cases one side of a street is lower than the other, and if the sewers are built on this side, there will be no need of cutting as deep a trench to serve the houses on the downhill side. Moreover, sewers built in the center of a street cut off the traffic from the whole street if it happens to be very narrow. If an up-to-date pavement is opened at or near the center of the street, little better than a patch job can be obtained after it is repaved, and in rural sections space will often be found along the side of the road where the paving will not have to be disturbed.

It is not always good policy to build sanitary sewers very close to the curb line. Where sanitary manholes are built in the gutters, and the sewage is collected by the separate system, and treated at a disposal plant, large quantities of rain water will enter the manhole covers, and add considerably to the quantity of sewage to be treated. Sanitary sewers near the curbs are also liable to become stopped up with tree roots if trees exist or are planted along the sidewalk.

Storm Sewers First

In cities where the separate system is in use, storm sewers should always be designed before sanitary sewers. Where these sewers interfere with each other, the sanitary sewers should be built at a lower elevation, because it is cheaper to lay them in deep trenches than the larger storm-water drains. When the Baltimore Sewerage Commission (1906-1916), which built fully 90 per cent of the sewers in Baltimore, started to work, it planned to lay very shallow storm-water drains, but so many underground structures were encountered that it was soon found to be cheaper to build these drains at least 5 or 6 ft. deep, with the sanitary sewers still deeper, than to go to the great expense of either raising or lowering the various obstructions that were encountered.

In residential sections in Baltimore the house connections were built from 7 to 9 ft. deep, and in business sections from 10 to 13 ft. Experience soon demonstrated that in business districts it was much cheaper to construct sanitary sewers in tunnels than in trenches. In one case a merchant lost a thousand dollars due to the diverting of traffic from the street on which his store was situated to another street because of the deep sewer trench which was dug in front of his property.

Where interceptors or trunk sewers are built in a street at a considerable depth it is often better to serve the adjacent houses with a lateral sewer than to build vertical standpipes to connect each house with the larger sewer Large pipes with "Y" connections are expensive; vertical standpipes are difficult to construct and maintain; a large sewer with many house connections on it is hard and unpleasant to inspect; and the multitude of flows from these house connections entering the large sewers at many points cause considerable eddying.

House Connections

In Baltimore two types of house connections are used: single and twin. The single house connection consists of a 6-in. pipe, running from the lateral sewer to the house. The twin house connection has a 6-in. pipe running from the sewer to the curb line, with two 5-in. branches to the two adjacent houses. It might seem that there would be an excessive number of stoppages in twin house connections but in Baltimore there have been fewer in these than in single house connections. Twin house connections considerably reduce the length of pipe to be laid, and where rock is encountered their use is to be especially recommended. When excavation is difficult, it is also a good plan to dig one trench from the lateral sewer to the building line, and lay two house connections in it.

No outside running traps are permitted on house connections in Baltimore except on a few combined sewers. This ruling was made effective some years ago in spite of a vigorous protest from the Master Plumbers' Association—which, later on, saw the advantages of not using running traps and withdrew its protest. The money saved has amounted to several hundred thousand dollars. Every house is provided with a vertical stack running a few feet above the top of the building and joining the house connection. Each stack permits an efficient means of ventilating the sanitary sewers. All of these sewers in Baltimore are free of gases, and, as a result, there have been no explosions in any of them. It has not been necessary to rely upon getting ventilation through manhole covers; so the number of holes in these covers have been reduced from six to two. A considerable quantity of storm water is thus kept out of the sanitary sewers, and the cost of pumping and treating the sewage is much less than it would be under other conditions.

Every large municipality should have a department where the locations and the depth of all proposed subsurface improvements are approximately determined. If the different city departments and the public service corporations, such as telephone and gas companies would agree before hand as to the locations of their proposed work, large sums of money would be saved. As it now is in many cities, various underground structures are so situated that much additional money has to be spent in either moving these improveemnts or in digging deep trenches to get under them. The above mentioned department should be under the supervision of a man familiar with the design of sewers, for of all the subsurface improvements the layout of a sewerage system requires the most knowledge and study.

LETTERS TO THE EDITOR

It is the editors' desire to publish here all worth-while letters pertinent to the interests of engineers and contractors. In order that this may be possible contributors are asked to condense their letters to the shortest space consistent with a clear presentation of their ideas.

Does Licensing Make For Responsibility

Sir—In a recent issue of your periodical, I read with some interest of the collapse of a dome on a church at Long Beach. In your editorial comments you state as follows: "So far as it rests on engineers, we are making progress in fixing such responsibility and making sure that they are competent to bear it. License laws and joint action through societies will accomplish this result."

I have never yet seen any reason to suppose that license laws will accomplish any such results as you seem to think they will. I have had some experience in license laws in regard to engineers and architects in various states, and so far as I have been able to determine they have never accomplished anything except bothering competent engineers.

Springfield, Mass., March 17. SAMUEL M. GREEN CO., S. M. Green, President.

Elastic Soil Again

Sir—I dislike to renew or prolong a controversy with my friend Lazarus White, but there are certain statements in his letter in *Engineering News-Record* of March 10, p. 439, that appear to me to be partly due to a careless interpretation of my own of Jan. 27, p. 185, and partly to jumping at conclusions from his own observations of soil phenomena. First, I want to say that I heartily endorse, as I have heretofore done, the method of holding the rebound by wedging or otherwise as devised by Mr. White. I do say, however—and I ask that this be not misunderstood—that if I have to choose between a supertest of 50 to 100 per cent in excess of the load and not hold it, and a test of the actual load and hold it, I prefer the supertest. It would be absurd, however, to say that both factors should not be had if possible, and therein, as I have observed in many cases, lies the value of Mr. White's pretest method. He gets both factors, though he inadvertently gives the impression that the supertest is not important. My only criticism of the wedging-and-holding factor is that, as Mr. White himself claims, he only holds a percentage of the test load by wedging, i.e., he does not attain perfection but approaches it some 32 to 50 per cent nearer than with the supertest alone.

As to appreciable elasticity of soil, I am willing to be shown. I do not, of course, deny the existence of elasticity, but I do not believe that it is a sufficiently large factor to be observed in ordinary working conditions. Mr. White would have us believe (if I read him understandingly) that the elasticity of soil is very many times greater than that of steel. I quote from his letter of Mar. 10, "Rebounds of ⅜ in. have been observed for piles 10 ft. long where the elasticity of the pile itself would account for only 1/50 inch." Let us analyze this. Take his own diagram illustrating the bulb of pressure, in his article of Dec. 30, 1920, p. 1268. The radius of ultimate area stressed is about 5 ft.; then with a 10-ft. pile showing an elastic reaction of 1/50 in. and 5 ft. of soil accounting for the balance of the ⅜-in. elastic rebound we find the elasticity of the soil roughly 40 times that of the steel shell pile. This method of getting at the elasticity of the soil is like the good old method of measuring skin friction: if a pile of the equivalent area of 1 sq.ft. carries 20 tons, and 4 tons is all the soil should stand, then 16 tons are ascribable to skin friction—the deduction is perfect.

Now I don't think Mr. White intends to imply just what he seems to say and I may have misinterpreted him, and if so I am willing to be corrected, but what he did not consider is the main factor of the rebound of the pile; that is, the slight but cumulative tendency to distortion the elasticity of which could easily account for the whole of the ⅜ in. in the rebound.

Just a further word as to practical considerations. Except in bogs or the like, where the reinforcement of the soil by fibrous matter gave it a tensile strength and an elastic factor, I have never noted in observations of soil in tunnels, trenches and foundations any visible evidence of elasticity. I have always observed that when anythings drops into or on ground or yielding soil with a dull sickening thud it "stays put" and if removed from a hole made by it the hole does not change observedly in dimensions. If we take a ½-in. bar and drive it into a sandy soil with the swinging blow of a 20-lb. sledge (my own limit is about a 10-lb. one) we will find I think there is no appreciable rebound, and yet the load in the soil, taking the blow at 200 lb., is equivalent to a load of 75 tons per square foot. It seems to me that if the soil is as elastic as some of our friends would have us believe that we would have more ordinary piles bounding out of holes under hammer blows than would stay in place.

In our early experiments with sectional shields in tunneling we sometimes found that a cobble not larger than a man's two fists would stop the shield section, and I have seen the pressure as measured by gauge run up to 10,000 or 12,000 lb. on a 3½-in. ram. Then when the cobble was found and dislodged with the ram still under pressure, I have seen the shield jump ahead ½ in. from the elasticity of the reaction blocking. In other cases I have seen the piston of the ram run back 1½ in. when released from 10,000 lb. pressure while the reaction blocking expanded and straightened some 20 ft. back with much creaking and groaning and the head of the shield stood absolutely still.

J. C. MEEM,
Engineer for Frederick L. Cranford, Inc.
Brooklyn, March 15.

Stresses in Reinforced-Concrete Chimneys

Sir—Referring to the letter from Frank S. Bailey in your issue of March 3, 1921, p. 393, calling attention to the difference in results obtained from Mr. Wolfe's graphical method and Turneaure & Maurer's analytical method for the analysis of the cylindrical section given on p. 408 of Hool & Johnson's "Concrete Engineers' Handbook," please note that at the close of Mr. Wolfe's analysis he states that the maximum steel stress is the distance $rY = 710 \times 15 = 10{,}650$ lb. per square inch. Obviously, this should be the distance dY, which, as nearly as can be read from the very small scale shown, is $546 \times 15 = 8{,}200$ lb., the correct steel stress. The maximum concrete stress is, as stated, 479 lb. These results vary about 7 per cent or 8 per cent from those obtained from an analysis using the Turneaure & Maurer curves and the variation is consistent for both the steel and concrete stresses. Analyzing the same section by the method given in Taylor & Thompson we find the stress in the concrete to be 536 lb. and in the steel 8,860 lb., which agrees very closely with Turneaure & Maurer.

In Taylor & Thompson's method the reinforcing steel is assumed to be placed at the center of the concrete ring and for this particular section with an inside diameter of only 4 ft. and shell thickness of 1 ft., this assumption probably accounts for the difference in results between the graphical and analytical methods. For most reinforced-concrete chimneys where the diameter is four or five times as great and the shell thickness approximately the same the error in the analytical method is negligible.

Referring to the much greater discrepancies between the results of the various methods in the case of a 200-ft. chimney with a diameter of 20 ft., which Mr. Bailey mentions, I believe the discrepancy will be found to lie in an error in the application of Mr. Wolfe's graphical method, as such an error with its resultant discrepancy puzzled the writer for some time. In Mr. Wolfe's method the neutral axis of the chimney as a reinforced-concrete beam is first found, a maximum stress in the concrete is assumed and

the resisting moment of the chimney determined. The actual stress in the concrete is then determined by proportion between the resisting moment thus found and the moment of the eccentric load about the *neutral axis*, after which the effect of the direct load and the remainder of the bending is determined. It is therefore necessary to the application of this method that the line of action of the normal component of all loads lie farther from the tension side of the chimney than the neutral axis of the chimney as a beam, in order that its bending moment about the neutral axis may be determined. When this normal component acts between the neutral axis and the tension side of the section, Mr. Wolfe's graphical method does not apply.

The common error in this case and one that is easily made in using the graphical method is to take the moment of the normal component of the loads about the center of the chimney section and then proceed with the graphical solution, in which case the resulting stresses will be in error and much in excess of the true stresses. Of course, I do not know the section of the 200-ft. chimney to which Mr. Bailey refers, but since he states that the resultant falls close to the edge of the kern I have little doubt that the graphical method will not apply and was probably used erroneously to obtain the results to which Mr. Bailey refers.

For actual reinforced-concrete chimney sections to which the graphical method will apply, and this is seldom the case, the results should agree closely with both Turneaure & Maurer and Taylor & Thompson's analytical methods.

E. A. DOCKSTADER.

Boston, Mass., March 15.

Sir—Mr. Bailey may be interested to know that I once attempted to apply the graphic method cited to round columns in buildings and concluded upon examination that the method is in fundamental error, in that at the outset the bending is calculated from the neutral axis, whereas it is the geometric central axis from which the eccentricity must be measured as in the preceding examples, pp. 387 and 394, of Hood & Johnson. Otherwise we might assume the special case of the normal force or load along the neutral axis, and get no bending moment, although such a position of the load is eccentric.

The second error is in combining stresses derived from considering the load alone, and then flexure alone. This can only be done without error when there is no resulting tension in the section. This error, however, is mentioned but it is not brought out that the effect of it is to change the slope of the stressed plane section and thereby vitiate the results.

When tension exists over part of the section and tension in the concrete is neglected relations are too complicated when expressed in a formula for round columns or chimneys, and the only workable, quick solution is by a diagram, such as given on p. 816, Hool & Johnson.

Toronto, Ont., March 11, 1921. E. S. MARTIN.

Protective Coatings for Sea-Water Concrete

Sir—In connection with the articles in *Engineering News-Record*, March 25, 1920, p. 621, and Jan. 20, 1921, p. 121, on the subject of the deterioration of reinforced-concrete piles in sea-water in California, I would like to present the following remarks:

It seems to be well established that deterioration takes place only between high and low water, and when the concrete is permeable, because on each tide the concrete soaks up new sea-water which renews the chemical attack on the concrete. Under these conditions, no matter how weak is this attack, its renewal by new sea-water twice a day finally results in producing lamentable results.

The remedy is to make concrete impermeable. M. Voisin, chief engineer, Ponts et Chaussees at Boulogne-sur-Mer, has devised the following method: (1) The concrete is mixed 450 kg. of cement to 800 liters of gravel and 400 liters of sand. (2) This concrete is covered with a thin coating of pure cement paste. (3) On this coating is then applied two coatings of boiling coal tar, the second not being applied until the first is perfectly dry.

This method has given perfect results without any trace of decomposition observable in the concrete after ten years and imitating the work at Boulogne-sur-mer, the method has been adopted in other French ports. I believe that this proceeding may be adopted with success in the United States and notably on the Pacific Coast.

I think that one might advantageously replace the coal tar by paraffin which will not melt except at a temperature much higher than that which is common in that region in the warmest days in summer. For work in California already built, I think that its life can undoubtedly be prolonged by the application to the concrete from low to high water in the following process: (1) A covering of pure or almost pure cement paste applied perhaps by the cement gun. (2) Two coatings of boiling paraffin, the first not being applied until a month after the cement coat, the second two or more days after the first, and both of them in dry weather.

LOUIS RAVIER.

Paris, France, March 7.

Bridge Paneling and Ruggedness

Sir—A. W. Buel's article on page 463 of your issue of March 17, discussing the Georges Creek bridge accident, and your editorial in connection therewith, will, I hope, bring forth some useful discussion on this matter, which is one of great importance in bridge design.

Your editorial statement that "The relative service resistance of simple and subdivided systems is in the last analysis not a theoretical question but a question of fact, to be determined by service experience," may be granted, I think, by everyone. However, the case discussed does not prove that had the Georges Creek bridge been of simple-panel design the bridge would not have withstood the punishment it received equally well, if not better.

It is generally accepted by bridge engineers that panel subdivision complicates the detailing with an attendant pound-price increase, and renders the span subject to considerably more vibration, owing to the comparatively light truss members. Consequently, with a higher vibration percentage (other things being equal), we have an increased impact effect upon members, and it would therefore appear that the heavier members of a simple system are more capable of withstanding the punishment from derailment.

In my opinion Mr. Buel accounts for some of the principal reasons why the Georges Creek bridge made such a good showing in this accident when he describes the heaviness of the gusset plates, the planing of sheared edges, and the otherwise stringent fabrication specifications.

One point frequently lost sight of is that the relative ruggedness of simple and subdivided panel trusses varies with the amount of section loss through corrosion, there being a larger area of metal per ton exposed to the elements with the subdivided system, and an increased difficulty of properly protecting inaccessible parts when repainting. Other points in favor of a simple system are apparent; for instance, the desirability of making the shopwork as simple as possible so as to reduce the possibility of doubtful workmanship, and the reduction of secondary stresses in the truss members. It should be remembered that live load is approximately twice as destructive as dead load on account of the stretching and relaxing of the metal. This element certainly favors a simple truss system.

The writer is from Missouri when it comes to believing that a subdivided panel system is best for 150-ft. railroad spans, but hopes, as stated before, that the matter will be thoroughly discussed.

F. H. FRANKLAND,
Consulting Engineer.

New York City, March 21.

Fire Loss in Terms of New Construction

According to reports published in the Jan. 15 and Feb. 12 issues of *Bradstreet's* (New York), the value of new buildings reported in 1920 by 163 leading cities is $1,408,610,000. The insurance adjustments on account of fire losses in 1920 amounted to $330,853,925, or 23.5 per cent of the value of new buildings. This is not an exceptional case, as shown by data for other years.

HINTS FOR THE CONTRACTOR

Monthly Suppers Stimulate Enthusiastic Spirit at Wilson Dam

MONTHLY suppers of the leading men in the supply division of the Wilson Dam, being built by the Government across the Tennessee River at Muscle Shoals, Ala., were an important factor in developing enthusiasm and effective service in that division. At the request of *Engineering News-Record*, Major S. C. Godfrey, Corps of Engineers, U. S. A., chief of the supply division, has written a brief statement of the reason for holding these suppers and their effect upon the work of the division. Major Godfrey's story is as follows:

In the spring of 1920 the problem of securing equipment, material and supplies for the Wilson Dam was a critical one. The construction work was being pushed vigorously, but the market for engineering material was so congested and the railroad facilities were so inadequate to handle the heavy demands being made, that the construction bid fair to be seriously hampered. It was exceedingly difficult, for instance, to secure cement in quantities adequate for concreting needs. The railroads at that time could not move the cement that was offered and available at certain mills. This problem was solved by the purchase of seventy-five box cars which were put into service between the cement mills and Wilson Dam, and which proved during the summer and early fall of 1920 practically the only resource that the government had in order to procure cement. In full operation the needs for concreting aggregated about ten cars of cement daily.

Another vital problem of supply consisted in the procurement of sand and gravel from the Tennessee River for concrete aggregate. The sand and gravel is dredged by two 15-in. suction dredges at a point 12 miles below the dam. It is pumped to the top of two screening and washing plants adjacent to the dredges. After being separated it is deposited on barges and hauled by towboats to an unloading dock three miles from the dam, where it is unloaded by two gantry cranes into the cars which convey it to the mixers. The entire dredging and handling plant had to be assembled and put into smoothly running order under the adverse conditions above referred to and to build up to a production basis of 2,000 cu.yd. of material a day.

NEED FOR CO-OPERATIVE EFFORT

Under these conditions it was extremely desirable to instill into the members of the supply division who had all of these problems in hand, a realization of the magnitude of their task, and a spirit that would overcome obstacles. The heads of the various departments, therefore, in conference with the chief of the division, agreed upon a plan of holding monthly suppers of a semi-official and semi-social nature.

These suppers were attended by some thirty or more of the employees holding responsible positions. They were held in different mess-halls on various parts of the work, at a charge to the employees of the actual cost of the food. At the first suppers a plan was carried out for each department of the supply division to explain, informally, its organization and problems to the other departments, in order that all branches—purchasing, traffic, storage, finance, sand and gravel procurement, etc.—might work together more effectively through a better understanding of their respective functions.

Later on chiefs of other divisions and departments were invited to meet with the supply division, and in the same informal way the needs of the construction divisions, which the supply division was endeavoring to meet, were taken up and discussed from the point of view of more effective service. In these talks various engineers told of the design of the dam, described the units which would furnish the power, and in other ways gave members of the supply division a more intelligent conception of the problems that they were helping to solve.

Throughout these discussions it was emphasized that the supply division had a function like that of the S. O. S. in France—to adapt itself to the "front-line" needs, to help the construction men foresee their own requirements for material and supplies, and to make every effort to get those necessary supplies to the job on time.

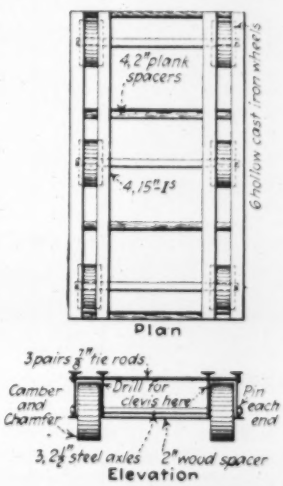
At the eighth supper employees were invited to bring their wives and immediate relatives. The attendance at this supper was over one hundred, and included superintendents, clerks, dredge operators, foremen, steamboat masters, storekeepers, typewriters, electricians, laborers, in fact an assembly representative of the entire work.

As a whole these suppers are believed to have contributed materially to the effectiveness of the service rendered by the supply division and to the morale of its employees.

All-Steel Truck for Heavy-Duty Transfer Work

BY D. H. FLEMING
Town Engineer, Owen Sound, Ontario

FOR moving heavy machinery such as contractors' hoists, boilers, etc., the heavy-duty trailer shown herewith has been used. It can be drawn by team, tractor or truck. Its special feature is the wheel arrangement, making turns at street corners easy. The middle pair of wheels is placed from one-half inch to an inch above the other two pair so that the whole teeters on the two opposite wheels at the middle of the truck. For freedom of movement, none of the wheels are secured to the axles so that they may turn backward while others turn forward.



Water Sewerage and Wastes in Wisconsin

A classification of water supplies, sewerage systems and industrial wastes in Wisconsin has been made by the state sanitary engineer, C. M. Baker. Of the 46 surface supplies 10 are filtered and chlorinated, 12 are chlorinated only and 24 are untreated. Of the 224 ground water supplies 100 are shallow wells, springs and infiltration galleries and 124 are artesian or deep wells. There are 163 sewerage systems of which 13 have the tank-and-filter system, 49 have tanks only and 101 have no treatment. Of the 4,390 plants producing industrial wastes 139 are canneries, 40 coal tar or gas plants, 3,901 milk products, 52 packing or rendering plants, 63 paper and pulp mills and 195 miscellaneous.

NEWS OF THE WEEK

New York, March 31, 1921

Mayor Shakes Up Pittsburgh Engineering Bureaus

Drops Experienced Men—Chief Engineer Sprague Dismissed—Swan and Others Resign

Norman S. Sprague, chief engineer of the Department of Public Works of Pittsburgh, was removed from office by Mayor E. V. Babcock on March 17 through a letter of dismissal charging that Mr. Sprague had lost the confidence of the city council as well as that of the public, and that not enough progress has been made on the public improvements provided for by a bond-issue referendum passed in July, 1919. At the same time John Swan, director of the department, resigned his office; a day later John F. O'Toole, superintendent of the Bureau of Highways and Sewers of the same department, and S. A. Dies, superintendent of building inspection, also resigned. Mr. Sprague had been with the Department of Public Works for fourteen years, Mr. O'Toole had served for the same length of time, and Mr. Dies held his position for eighteen years. Mr. Swan had been director for four years past, having been appointed late in 1916 to succeed the late Robert Swan, his brother.

Politics Responsible

Politics is believed to be responsible for the shake-up. At a meeting of the Pittsburgh Section of the American Society of Civil Engineers, held March 20, resolutions were passed expressing the confidence of the section in Mr. Sprague's ability and integrity, and asserting that his dismissal should not be construed as reflecting upon his professional ability and reputation.

It is stated by the mayor that the Bigelow Boulevard landslide of last November and the council's investigation of the responsibility for the slide played no part in Mr. Sprague's removal. As concerns the charge of slow progress in initiating and carrying out already authorized public improvements, Mr. Sprague, in a public statement, has stated that bond-issue contract work to the amount of $1,034,000 was completed during the past year, and that nearly $1,500,000 of contract work is in progress, in addition to a larger amount of tax and special assessment improvements; and that plans are completed and ready for advertisement for bids upon bond-issue improvements totaling more than $1,000,000, while plans for an equal amount of work are in preparation. However, it is said to be the Mayor's purpose to put the 1919 bond-issue improvements in the hands of a special engineer, instead of the public-works department, in order to have the work completed as soon as possible.

Colonel Sherrill Named as President Harding's Military Aide

President Harding has selected Lieut.-Col. Clarence O. Sherrill, Corps of Engineers, as his military aide and as superintendent of public buildings and grounds. Col. Sherrill is a native of North Carolina. He was an honor graduate of the U. S. Military Academy in 1901. He also was graduated with honors from the School of the Line and from the Staff College. For several years following his graduation, he was instructor at the Army schools.

LIEUT.-COL. C. O. SHERRILL

From 1910 to 1914 Col. Sherrill was stationed at New Orleans on river and harbor work, after which he spent a year in the Philippines on fortification work. He then was sent to Panama where he spent two years in charge of the fortification construction.

With the outbreak of the war Col. Sherrill was assigned to the command of the 302nd Engineers. During the Argonne offensive he served as chief of staff of the 77th Division. Later he went to Germany as assistant chief of staff of the Third Army.

Since his return to the United States Col. Sherrill has been in charge of fortification work in the office of the Chief of Engineers. He is a member of the Board of Surveys and Maps and of the Interdepartmental Board on Alaskan affairs.

Col. Sherrill was aide to President Roosevelt in 1903 and 1904 and to Gen. J. Franklin Bell in 1904 and 1905. He was decorated by the French with a Croix de Guerre, with palm, for services rendered the French army during the fighting on the Vesle.

Federal Highway Policies Under Consideration

New MacArthur Bill to Be Introduced—Many Members of Congress Preparing Bills

(Washington Correspondence)

With the necessity facing Congress of evolving a new highway policy or putting its stamp of approval on the existing federal-aid plan, various legislative ideas now are taking shape. To attract the maximum support any bill proposing a continuation of federal-aid must embody a provision that states, rather than their subdivisions, are to meet the federal appropriation. Exceptions probably will be allowed in cases where a large local program is necessary.

It is admitted that such a measure must make it mandatory that maintenance be carried on only by the state highway departments. Most of the state highway officials are understood to stand with Thomas H. MacDonald, chief of the U. S. Bureau of Roads, in his declaration that "the present plan of allowing maintenance funds to be provided by localities will not prove satisfactory in maintaining the projects which are built with the use of federal aid, and this condition can be prevented if the maintenance funds are supplied by the state and administered by the state highway departments."

MacArthur Bill Revised

Representative MacArthur, of Oregon, is expected to introduce at the opening of the extra session a bill which will embody the ideas of the state highway officials. The bill will follow the general lines of the measure introduced by Mr. MacArthur at the last session, but it will be revised in a number of particulars. The new bill will not carry an appropriation, but will simply authorize such sum as may be agreed upon by the appropriations committee. There is every reason to think, however, that an appropriation of $100,000,000 per year will be forthcoming if a federal-aid bill becomes a law.

Other features of the original MacArthur bill which probably will remain are as follows:

A modification of the present equal ratio of co-operation between the Federal Government and the States, whereby the portion of the total cost of the road project borne by the Federal Government is increased in proportion to the amount of publicly owned land within those States more than 10 percent of whose area consists of public land; the provisions for a road program in the national forests; the extension of federal-aid to Alaska and to Hawaii; the extension of preference in the construction of roads which will expedite

the completion of a national highway system.

A number of members of Congress are known to be preparing bills. All of these measures will go before the Committee on Roads where the ideas meeting with approval will be merged.

Mechanical Water Filtration for Cambridge, Mass.

Bids for a mechanical water filtration plant for Cambridge, Mass., are to be received by the city April 12. The work includes a concrete sedimentation basin 97 x 137 ft. x 17 deep, 10 concrete filters, each to give a net area of about 480 sq.ft.; a concrete clear-water basin about 148 x 276 ft., x 16 ft. deep; a wash-water receiving basin about 38 ft. in diameter by 12 ft. deep; four electric-driven centrifugal low-lift pumps with a total capacity of 26 m.g.d.; a 29 x 34-ft. steel wash-water tank; filter accessories, piping, etc.; and a two-story concrete and brick building, 77 x 216 ft. in plan. George A. Johnson, New York City, is consulting engineer.

Iowa and Illinois Water-Works Men Hold Joint Meeting

Five Middle West states were represented March 23 and 24 at the meeting of the Illinois and Iowa Sections of the American Water-Works Association. Combined annual meetings of sections suggested by Charles R. Henderson are planned beginning in the fall of 1922, leaving the spring open for individual section meetings and the summer for the large general meeting.

Seven technical papers were presented and an excursion to Chicago pumping stations was made. R. Edman Greenfield, chemist, Illinois State Water Survey, explained by demonstration the term hydrogen-ion concentration. S. A. Greeley, consulting engineer, gave comparative operating data of the Evanston, East Chicago and Whiting rapid sand filters.

Walter A. Shaw, former commissioner, Public Utility Commission of Illinois, read an extended paper on "Fixing Rates for Public Utilities by Contract," and C. M. Roos, superintendent, Cairo (Ill.) Water Co., followed with views of the same problem from the utility standpoint. F. H. Mathews, of the Utility Commission, discussed the grading of utilities from the layman standpoint. "Take the public into your confidence," was the burden of both his talk and that of Mr. Roos.

D. H. Maxwell, with Alvord & Burdick, outlined the geological difficulties Bloomington, Ind., has in finding a reservoir site that will hold water. John Ericson, consulting engineer to the city of Chicago, indicated that Chicago could not afford to filter its supply until it reduced its waste. The daily consumption is 265 gal. per capita.

The newly elected officers of the Illinois Section are as follows: Chairman, John W. Alvord; vice-chairman, Henry R. Ringness; treasurer, H. E. Keeler; new trustee, Dr. A. M. Buswell.

To Tax Gasoline in California

A bill was recently introduced into the California Legislature providing for a tax of one cent per gallon of gasoline, distillates, and fuel oils used in motor vehicles.

New Head to Wind Up Railroad Administration Affairs

President Harding has named James C. Davis of Iowa, who has served as general counsel to the Railroad Administration, to succeed John Barton Payne, who resigned a short time ago as Director General. Mr. Davis' duties will be concerned largely in winding up the affairs of the Railroad Administration.

Federal Power Commission Issues New Rules

Effective Feb. 28, 1921, the Federal Power Commission issued orders No. 9 which embody rules and regulations of the commission. Any one doing business before the commission, making application for permits or licenses, etc., must do so under the rules laid down in this book, which can be obtained from the Federal Power Commission.

Manchester Building Three School Structures

The city of Manchester, N. H., is carrying on a school building program, included in which is the construction of two high schools and a grammar school, the total cost of the three buildings to be in the neighborhood of $2,000,000. The largest of these buildings is the Practical Arts High School, 180 x 70 ft. with an ell 80 x 70 ft. and costing in the neighborhood of $1,000,000. The work is under way, I. S. Woodbury & Sons Co., general contractors of Boston, being in charge.

Legislature to Investigate Illinois Roads

Full investigation of the highway situation in Illinois is contemplated in a joint resolution of the State Legislature. The resolution provides that a committee of three from the Senate and three from the House be appointed to investigate and report to the present general assembly union: The establishment of a permanent, uniform and efficient system of road improvement and maintenance throughout the state; the promotion of a county system of road improvements and maintenance by extending dirt road improvement and the use of gravel, or similar material where advisable; the establishment of the so-called Wisconsin patrol system; the sentiment for and advisability of changing the construction to be used on bond-issue roads from cement or brick to some other construction; the best methods of treatment of dirt roads with oil or other material and the subsequent proper care of such roads. The joint committee is directed to report to this session of the general assembly, and an appropriation of $2,500 is made to cover the expense of the investigation.

Molasses Tank Trial Resumed

After a recess of several months the trial of the famous molasses tank case in Boston has been resumed and rebuttal testimony of the plaintiffs is being presented. The case put in by the defendants, the United States Industrial Alcohol Co., to show that the failure of the tank on Jan. 15, 1919, was caused by a bomb explosion, was summarized in *Engineering News-Record*, Oct. 7, 1920, p. 691.

Flat-Slab Reservoir Roof at Canton, O., Collapses

A section of the roof of the equalizing reservoir being constructed for the City of Canton, Ohio, collapsed sometime during the night of March 2. The reservoir is a reinforced-concrete structure approximately 283 x 360 ft. in plan, with an average depth of 22 ft., and a capacity of 15,000,000 gal.

The roof of the reservoir, which is of the flat-slab type, was poured between Oct. 1, 1920, and Jan. 14, 1921. Centers were constructed for the entire roof slab, and allowed to remain in place for approximately 60 days. In fact, a large part of the inside forms have not as yet been removed. About Feb. 1 work was started placing the earth cover over the reservoir. On Feb. 15 the resident engineer noticed some small checks or cracks in that part of the slab on which the earth cover had been placed and ordered the contractor to stop placing the earth.

On the morning of March 3 it was found that sometime during the preceding night a large part of the section on which the earth cover had been placed had collapsed. An investigation was immediately started to determine the cause of the failure and the James H. Herron Co., of Cleveland, Ohio, and Sanford Thompson of Boston, Mass., have been retained by the consulting engineers, Morris Knowles, Inc., to make an investigation and report. In addition, the city of Canton has retained the Pittsburgh Testing Laboratories. The tentative conclusions reached by the James H. Herron Co. and Mr. Thompson agree that the failure was caused chiefly by the slow hardening of concrete, due to cold weather; that, however, the balance of the slab, if given sufficient time, will develop enough strength to carry the load for which it was designed.

Reclamation Service Program Must Be Curtailed

Because of indications that receipts from oil land leases payable to the reclamation fund will be nearer $12,000,000 than the $20,000,000 estimated, the U. S. Reclamation Service will not be able to carry out the entire construction program authorized at the last session of Congress. Director Davis has authorized, however, the early inauguration of the work of building the Tieton reservoir in the Yakima valley. This reservoir is an extension of the storage system in that valley. It will provide 185,000 acre-ft. of additional storage.

New York Legislature Passes Port Treaty Bill

The New York Port Treaty Bill was passed by the Senate of the New York Legislature, March 23, by a vote of 31 to 11, following its passage by the Assembly the week before. At this writing it is in the hands of Governor Miller for his signature. The Governor had previously urged passage of the bill.

The New York State bill authorizes any two of the three New York members of the New York, New Jersey Port and Harbor Development Commission to enter into negotiations with commissioners from the State of New Jersey to draw a compact between the two states in the form of a Port Treaty, the terms of which are included in the bill and which provide for the creation of the New York port authority. A similar bill has already passed the Senate of the New Jersey Legislature, but at this writing has not yet been acted on by the lower house. The New Jersey Senate bill provides for the appointment of commissioners by the Senate. The democratic Governor of New Jersey is said to oppose the port treaty measure and it has largely become a party issue. Republicans predominate in both branches of the New Jersey Legislature.

A second bill was passed by the New Jersey Senate, March 28, naming the present three New Jersey members of the bi-state commission to membership on the port authority when the port treaty is signed. No votes were cast against the measure.

In New Jersey opposition to the Port Treaty continues from Jersey City organizations, but the measure has received the support of the chambers of commerce of other port municipalities including that of Newark.

A. A. E. Railroad Conference

Questions of education and co-operation with the management rather than those of compensation were predominant in the reports of delegates to the third annual railroad conference of the American Association of Engineers held March 14 in Chicago. About 65 roads were represented with 100 members present. No changes were offered in the 1920 salary schedule. A resolution asked for two weeks' notice of the managements in case of reduction of force.

The change in activity away from compensation was marked in the brief reports made by delegates from the various sections. Regular meetings, where established, have had for discussion methods of increasing the ability of members based on the principal that the engineer, like everybody else, in the long run gets what he deserves. Many of the A. A. E. sections are therefore learning other phases of railroading than engineering so that they will be better fitted to be promoted into executive positions. W. L. Lewis of the Great Northern read a paper giving the details of a plan in operation on that road which was being carried out by classes in conjunction with the management. Most of the sections reported close contact and co-operation with the management and expressions of loyalty to it were numerous.

A paper by J. D. Trueblood, Chicago & Northwestern Ry. analyzed the statistics as to the attendance of civil engineers in seven universities in the Middle West. Both enrollment and graduates have fallen off as compared with the numbers taking other courses.

Indiana Conservation Department Gets Money for Engineers

The Indiana State Department of Conservation was established in 1919 with five divisions: fish and game, geology, entomology, land and waters, and forestry. This year a division of engineering has been provided for with an appropriation of $15,000, which becomes available April 1. While the main feature of the work to be undertaken will be drainage and land reclamation, some attention will be paid to stream pollution. In fact, work on the problem of disposing of sugar factory wastes at Decatur has been under way for some time. In this work there is to be co-operation with the activities of the State Board of Health.

The Conservation Department will work in conjunction with Purdue University, appointing a member of the engineering department as state engineer. Prof. W. K. Hatt is acting temporarily in this capacity. It is planned to have an assistant in Indianapolis to carry out details.

The powers of the new engineering division under the law provide for (1) investigations and recommendations relative to drainage and land reclamation, (2) surveys and mapping to enable more intelligent procedure of land drainage and reclamation, (3) recommendation and enforcement of drainage laws, (4) designation of natural drainage areas so that systems may be established economically and scientifically as an integrated whole, (5) computations of probable discharge and necessary capacities of channels and ditches and levee systems. Richard Lieber is director of the Department of Conservation.

Research Department Organized by Automotive Engineers

Organization of a research department is announced by the Society of Automotive Engineers in the March issue of its journal. The department will not conduct a laboratory or do research work directly, but will coordinate the work in outside laboratories, direct investigations at the Bureau of Standards and Bureau of Mines on fuels and other subjects in automotive engineering, supervise comparative tests in industrial laboratories, guide research programs to definite commercial ends, collect all available data on the important automotive subjects.

Chief of Engineers Allots Harbor and River Work

Allotments of river and harbor wo for the coming year have been made Major-General Lansing H. Beach, Chi of Engineers, U. S. A., carrying out t provisions of the $15,000,000 lump su river and harbor appropriation bill a proved March 1. An expenditure $2,500,000 is provided for locks an dams on the Ohio River; $700,000 fo Southwest Pass, New Orleans, an $500,000 each for Savannah Harbor Ga., river and mouth of Wiscon River, Detroit River, and Portland, Ore. Fo the Hudson River channel, New York Harbor, $450,000 is allotted, $100,000 for the Hudson River.

Allotments of $400,000 each are made for St. Johns River, Fla., from Jacksonville to the ocean; Hillsboro Bay, Fla.; Mississippi River between Ohio and Missouri Rivers, and for San Juan Harbor, Porto Rico. Other items over $100,000 are:

Mobile Harbor, Ala., $300,000; Galveston, Tex., Harbor, $100,000; Galveston Channel, $100,000; channel from Galveston Harbor to Texas City, $125,000; Houston ship channel, $260,000; Freeport Harbor, Tex., $150,000; Port Aransas, Tex., $230,000; harbor at Sabine Pass and Port Arthur canal, Tex., $160,000; Sabine-Neches canal, including Sabine River to Orange, and the Neches River to Beaumont, Tex., $125,000; Mississippi River, between St. Paul-Minneapolis and Wisconsin River, $200,000; Missouri River, Kansas City to mouth, $200,000; Cumberland River, below Nashville, $200,000; Tennessee River, below Riverton, $100,000; Ohio River, general open-channel work, $285,000; Ludington Harbor, Mich., $166,000; Calumet River, Ill. and Ind., $186,000; Coos Bay, Ore., $144,000; Yaquina Bay and Harbor, Ore., $145,000.

Various other smaller items are specifically included in the allotments. The amount reserved for contingencies is $2,361,700.

In allotting the river and harbor appropriation a year ago $1,484,118.99 was left for contingencies. It was not necessary to draw upon that sum. It now has been allotted as follows: Pollock Rip Shoals, Nantucket Sound, Mass., $150,000; Harbor of Refuge at Nantucket, Mass., $5,000; Ambrose Channel, Craven Shoal and Anchorage Channel, New York Harbor, $300,000; Woodbridge Creek, N. J., $9,000; Keyport Harbor, N. J., $20,000; Delaware River, Pa., N. J. and Del., Philadelphia to the sea, $1,000,000.

Illuminating Engineers to Meet

The annual convention of the Illuminating Engineering Society will be held in Rochester, N. Y., during the week of Sept. 26, 1921.

Sanitary Survey for Duluth

The Minnesota State Board of Health, at the request of the Duluth City Council, is about to undertake a sanitary survey of the water supply and sewerage. The distribution of sewage in the lake will be ascertained by a series of sampling stations. Recent complaint against the water supply, which is protected by chlorination, led the city to ask the State Board of Health to undertake the study.

Camden Bridge Report Expected by Early Summer

Present progress in the engineering investigations for the bridge across the Delaware River between Philadelphia and Camden is such that predictions are made by engineers close to the work that the report on best site and type and probable cost of the bridge will be rendered by early summer. Borings at the northern, middle and southern locations have reached rock on the Philadelphia side, all of them at practicable depths (80 to 110 ft.), while those on the Camden side are not yet completed. Work on superstructure studies is concerned both with the river span and with the approaches. Main spans of between 1,700 and 1,800 ft. will be required at the three sites, and the local conditions governing the choice of type are substantially the same. Designs of cantilever and suspension spans are under preparation, to serve as a basis for comparative cost estimates. In the approaches, the desirability of laying out ample entrance and exit facilities and yet avoid cutting off any of the already overcrowded streets of Philadelphia is considered essential.

Hearings held before representatives of the Corps of Engineers of the War Department with respect to clearance height for navigation were made the occasion for a strong argument by the engineers for the bridge in favor of a 135-ft. clearance height on a width of 800 ft., and against a requirement of 150 ft. height. This will give more ample navigation passageway than the Brooklyn bridge (which lies below the New York Navy Yard). Only a small amount of opposition from navigation interests developed. A decision on clearance height is looked for soon. Because of the vital dependence of the bridge layout upon the vertical clearance required by the War Department, progress in the planning may be delayed if a decision is long deferred.

Acting on conclusions of its engineers, the commission in its report to the Pennsylvania legislature, just rendered, states that if sufficient funds are provided the bridge can be completed by July 4, 1926, the sesquicentennial of the signing of the Declaration of Independence. An appropriation of $5,000,000 was asked, as Pennsylvania's share of the requirements of construction prior to the next legislative session in March, 1923.

Getting Society Members to Lunch

Every week the Rochester (N. Y.) Engineering Society sends out to its members a post card announcement of the weekly luncheon. A reduced copy of one of the cards is shown herewith.

ROCHESTER ENGINEERING SOCIETY

Enjo-Luncher's Weekly

NEWS NUGGET

1 JUNIOR SERIES 1

Powers Hotel — TUESDAY, MARCH 8, 1921 — Luncheon, 12:15

WE ARE FORTUNATE in the emergency to secure as our Speaker:—

Dr. Henry F. Cope, of Chicago, *author, lecturer and educator,* who, as Secretary of the Religious Education Association, is bringing to the Rochester Convention this week college presidents and professors from many parts of the land. He himself has lectured in all the leading universities of the country and is widely and favorably known. As an author he has some twenty books to his credit. As educator and child psychologist, he will blaze the way for the March 15th talk of Supt. Todd, of Industry, on "Boys" and the two addresses will blend admirably in our "JUNIOR SERIES."

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POSTPONED
Electrical Engineers' Day
In order to take advantage of much improved apparatus the "wireless" demonstration is to be postponed until MARCH 29

JUNIOR ENGINEERS
Vice Pres., Chas. C. Evans will preside this week or next and briefly describe the "Junior Engineers" which he organized and in which our Society should take an active interest when they resume next season. A word from a Boy Scout representative and from the Y.M.C.A. boys' dept. may also be expected.

Attendance last Tuesday 112

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WEEKLY POSTCARD SENT TO MEMBERS OF ROCHESTER ENGINEERING SOCIETY

Notices of the meeting and timely facts are featured and advertisements help pay the expense.

Maine Contemplates State Water Power Control

A proposed constitutional amendment which would give the State of Maine authority to control and develop water power was submitted to the Legislature recently in a message by Governor Baxter. The amendment will provide also for the taxation of all water powers and water power fees and hydro-electric energy generated therefrom. The Governor stated that by the terms of the Federal Water Power Bill the water powers of Maine are in danger of passing under Federal control and it well may be that the only method of preventing this is to levy a tax upon hydro-electric energy generated within the state and shipped beyond its borders. The Governor further stated that the constitutional amendment proposed would give the people an opportunity to decide for themselves whether the state should control and develop water power storage basins and undeveloped water powers.

Bill Fixes $4,500 as Salary for County Surveyors

A bill introduced in the Indiana General Assembly fixing the salaries of county surveyors in counties having a population of more than 200,000 at $4,500 a year has passed the lower House by a vote of 71 to 12. The bill provides that all fees now charged and collected by them shall be paid into the county treasury and they shall receive no additional compensation whatsoever as county engineer. The salaries of deputy surveyors and qualified assistants will be fixed by the Board of County Commissioners and will not exceed $200 a month for the first deputy nor $150 a month for each of the other deputies or qualified assistants. Rodmen, chainmen and other unqualified assistants shall not be paid more than $4 a day.

Surveys Board Names Officers

Officers of the Board of Surveys and Maps of the federal government for the ensuing year have been elected as follows: O. C. Merrill, Federal Power Commission, chairman; William Bowie, Coast and Geodetic Survey, vice-chairman; C. H. Birdseye, Geological Survey, secretary.

Indiana's Legislation Affects Engineer Interests

Numerous bills have been introduced during the present session of the Indiana General Assembly which have direct bearing either upon the construction industry or engineers as a profession. It is doubtful if such a volume of engineering legislation has ever been introduced in a previous Indiana Assembly.

A bill providing for the registration of civil engineers and surveyors and the establishment of a state registration board recently became law.

A bill to permit South Bend to come in under existing track elevation statutes and to aid in the consummation of track elevation plans now under way has been passed by the House unanimously.

A bill has been introduced in the Senate and referred to committee which would provide for the codification of all the drainage laws of the state. Senator Van Orman of Evansville has introduced a bill which would create a commission to investigate the advisability of constructing a bridge to cross the Ohio River at Evansville. The Senator will make an attempt to have the Kentucky Legislature to do the same at its next session in the hope of having the 1923 Indiana Legislature pass a bill to aid in financing the construction.

A Senate joint resolution appropriating $25,000 for a preliminary survey of a proposed inner harbor at Wolf Lake in Lake County and the appointment of a commission of two by the Governor to meet with a similar commission from Illinois, passed unanimously.

Civil Service Examinations United States

For the United States civil service examination listed below apply to the United States Civil Service Commission, Washington, D. C., or to any local office of the Civil Service Commission.

Chief Draftsman (aeronautical). Vacancy in the Naval Aircraft Factory, Navy Yard, Philadelphia, Pa., at $15.04 per diem and other vacancies requiring similar qualifications will be filled from this examination. Applications received until April 26, 1921.

Civil Engineer for vacancies in the Philippine Service, at salaries ranging from $2,500 to $3,000 a year, and in positions requiring similar qualifications.

Engineer, $2,400, or over, a year; Assistant Engineer, $1,800 to $2,340 a year; Junior Engineer, $1,440 to $1,740 a year. Vacancies in the Water Resources Branch of the Geological Survey. Applications rated as received until July 1, 1921.

ENGINEERING SOCIETIES

Calendar

Annual Meetings

AMERICAN ASSOCIATION OF ENGINEERS, Chicago; Seventh Convention, Buffalo, N. Y., May 9, 10 and 11.

AMERICAN SOCIETY OF CIVIL ENGINEERS, New York; Annual Convention, Houston, Texas, April 27-30.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS, New York; Spring meeting, Chicago, May 23-26.

AMERICAN WATER WORKS ASSOCIATION, Boston; Convention, Cleveland, June 6-10.

The American Specification Institute has been incorporated and a permanent organization was effected March 18 with the first board of governors consisting of the following: Chairman, Ralph W. Yardley, of Perkins, Fellows & Hamilton, architects; executive secretary, Gardner C. Coughlen, of Weary & Alford, architects; other members, C. L. Post, of the Condron Co., consulting engineers, Frank A. Randall, of Berlin, Swern & Randall, architects, and A. T. North, engineer. The organization will function as originally planned. (See *Engineering News-Record*, Feb. 17, p. 318). Headquarters have been established in Chicago.

The Vermont Society of Engineers, at its annual meeting March 9, elected the following officers: President, M. E. Carpenter; vice-president, holding over, G. R. Varnum; vice-president, C. A. Slayton; secretary, G. A. Reed; treasurer, T. W. Dix. The evening session was addressed by Governor James Hartness on the proposed affiliation of the society with the Federated American Engineering Societies, and by Alfred Patche of the Aberthaw Construction Co., Boston, who gave an illustrated lecture on ancient and modern engineering in Syria.

A Kansas City Section, Am. Soc. C. E. has been organized with the following officers: President, Alexander Maitland; vice-presidents, John V. Hanna and Col. E. M. Stayton; director, Louis R. Ash; secretary and treasurer, Henry C. Tammen.

The Providence Engineering Society (Structural Section), at a joint meeting with the **Providence Section, Am. Soc. C. E.**, was addressed March 22 by E. J. Mehren, editor of *Engineering News-Record* on "An Engineer's Observations of Economic and Engineering Conditions in Europe."

The Pittsburgh Section, Am. Soc. C. E., at a meeting March 20, discussed the subject of engineer licensing. C. S. Davis was delegated to appear on behalf of the section before a committee of the State Legislature March 23. The section passed a resolution of confidence in N. S. Sprague recently dismissed as head of the city's Bureau of Engineering.

The Southern Pine Association announces that there will be no postponement of its annual convention to be held in New Orleans, April 4-6. J. E. Rhodes of New Orleans is secretary-manager.

PERSONAL NOTES

J. H. ANDERTON has resigned his position as electrical engineer with the Stone & Webster Corporation to become a member of the firm of Thebo, Starr & Anderton, engineers and constructors, Sharon Bldg., San Francisco.

F. M. THEBO, of the firm of Thebo, Starr & Anderton, engineers and constructors of San Francisco, sailed for Japan March 19. The firm has been retained as consultant by a Japanese company that plans to construct a series of hydro-electric developments. Mr. Thebo will be gone for several months, during which time he expects to investigate field conditions, advise with officials of the Japanese company and organize the field forces.

W. D. SIMPSON has been appointed division engineer of the Florida division, Seaboard Air Line.

S. P. LONGSTREET, recently in charge of the Scranton district, Pennsylvania State Highway Department, has been appointed chief engineer of the Philadelphia district.

C. J. SWIFT has been appointed highway engineer of Blue Earth County, Minn.

E. F. MOORE, former business agent of the Hoisting and Portable Engineers' Union, has been appointed assistant chief engineer of the Sanitary District of Chicago. For the last five years he has been a member of the city board of examining engineers, which looks into the qualifications for stationary engineers. He has been in the employ of the various contractors in Chicago including the Foundation Company of Chicago, John Griffiths & Son Co., George B. Swift and W. J. Newman Co. For two years he was in charge of all mechanical equipment at the Mayfair shaft of the Wilson Avenue tunnel, which was built by day labor by the City of Chicago. He studied at Pauw University and also took a course in steam and electricity with the International Correspondence School.

EVERETT W. JENKINS, who has been connected with the engineering department of Worcester, Mass., for six years, has been appointed superintendent of streets in Quincy, Mass.

H. H. THURSTON, for the past year county highway engineer, Winona County, Minn., has resigned to enter business as a road contractor at Anoka, Minn.

FRANCIS M. HOWELL has been appointed special research assistant in engineering materials on the investigation of the fatigue of metals, College of Engineering, University of Illinois. From 1918 to 1920 he was assistant materials engineer with the Bureau of Construction and Repair of the Navy Department.

O. H. AMMANN, principal assistant engineer with Gustav Lindenthal, consulting engineer, has assumed the duties of assistant chief engineer of the Hudson River Bridge Co., of which Mr. Lindenthal is chief engineer.

CHADWICK & PIERCE is a firm of engineers and architects recently organized by Stanley H. Chadwick and Chauncey A. Pierce with offices in New York City.

JAMES ALLEN has been appointed supervisor of highways for the State of Washington.

R. C. SEMPLE, structural engineer, has opened offices in Seattle to engage in the designing, detailing, estimating and superintending of concrete and steel buildings. He was formerly with the Hofius Steel & Equipment Co., Seattle.

P. M. NICOLETT, recently engaged in supervising the construction of about 35 miles of federal and state aid road in Taylor County, Tex., has been appointed city engineer of Graham, Tex.

F. G. HERLIHY, formerly construction engineer with Winston Bros. Co., Minneapolis, Minn., has become general manager of the White Construction Co., Chicago. Under Mr. Herlihy's direction the White Construction Co., will extend its business from paving contracting to general contracting, giving particular attention to municipal work.

J. C. MCELHERNE, for the past two years assistant engineer with the state highway commission at Rochester, Minn., has been appointed engineer of Rice County, Minn.

FREDERICK W. SARR has been appointed first deputy highway commissioner, New York State Highway Department, by State Highway Commissioner Herbert S. Sisson. He was second deputy during Edwin Duffey's administration.

H. G. HOTCHKISS, recently assistant engineer in the Rochester Division, New York State Highway Department for several years, has been appointed second deputy commissioner.

IRA DYE, formerly with the American Frog & Switch Co., Hamilton, Ohio, has opened an office for the practice of industrial engineering in Seattle, Wash

A. D. PERKINS, JR., for nine and one-half years in the construction department, Southern Ry. Co., and recently assistant engineer North Carolina State Highway Commission, has again entered the employ of the Southern Ry. Co. in charge of some survey work at the completion of which he will be located at Washington, D. C., headquarters.

JACOBSON & MANSKE is a firm recently organized by F. H. Manske, contractor and engineer, and M. C. Jacobson, designer, to engage in contracting, engineering and designing work with offices in Wisconsin Rapids, Wis.

WOLF, SEXTON, HARPER & TRUAX is the name of a new partnership of engineers and architects in Chicago, organized by A. M. Wolf, civil and structural engineer, formerly with the Condron Co., F. A. Sexton, architect, L. M. Harper, mechanical engineer, and C. P. Truax, electrical engineer. The organization is prepared to handle all parts of the design of various types of structures.

B. L. TAYLOR has resigned as engineer of Woodbury County, Iowa, to enter general civil engineering practice, with offices in Sioux City, Iowa.

P. J. PRESTON, project manager U. S. Reclamation Service, Uncompahgre Project, Montrose, Col., has been transferred to the Yuma Project, succeeding W. W. Schlecht, resigned.

L. J. FOSTER, office engineer of the Denver office, U. S. Reclamation Service, has been appointed project manager U. S. Reclamation Service, Uncompahgre Project, Montrose, Col.

F. C. DUGAN has been appointed state sanitary engineer of Kentucky, with headquarters at Louisville.

J. R. BIBBINS, supervising engineer The Arnold Co., Chicago, has been appointed director of the new department of transportation and communication of the U. S. Chamber of Commerce in Washington, D. C., and will conclude his work in Chicago this month.

LESTER C. WALKER, from 1910 to 1920 with the Idaho Irrigation Co., Richfield, Idaho, as chief engineer in charge of all maintenance and operation, and recently with the U. S. Reclamation Service at American Falls, Idaho, is now watermaster for the Aberdeen-Springfield Canal Co., Aberdeen, Idaho, and has charge of all maintenance, operation and construction work for the company on a project of 65,000 acres.

R. D. MCGILL has been transferred from the Lincoln office of the Department of Public Works of Nebraska to Kimball, Neb., as project engineer in charge of federal aid project No. 16, consisting of 27 miles of earth road construction on the Kimball-Harrisburg highway.

C. C. MCCAMY has been appointed city engineer of Dalton, Ga.

E. PAUL FORD, recently associated with David H. Ryan in the construction of county highways, has been appointed city engineer of East San Diego, Cal.

E. A. MORITZ, engineer U. S. Reclamation Service, has resigned and his future address will be Effingham, Ill. He has been with the Reclamation Service since 1907 and his last assignment was project manager of the Flathead Project, Montana.

LIEUT.-COL. CRESWELL GARLINGTON, Corps of Engineers, U. S. A., has been designated to succeed Lieut.-Col. C. O. Sherrill as officer in charge of the fortification work in the office of the Chief of Engineers.

Y. M. KAREKIN has established temporary offices as consulting engineer in New York City. He was associated with the Westinghouse, Church, Kerr & Co. for fifteen years and with Dwight P. Robinson & Co. in the capacity of engineer in charge of industrial developments, especially railroad and terminal construction.

N. A. ECKART, formerly construction engineer in charge of the mountain division of the Hetch Hetchy Water Supply, with headquarters at Groveland, Cal., has been appointed chief assistant city engineer under City Engineer M. M. O'Shaughnessy.

OBITUARY

CHARLES W. ROOT, civil engineer, died Feb. 16 in Ashland, Ore. He was born in Mantua, Ohio, 1850. From 1881 to 1886 he was in the employ of the Oregon & California R.R. Later he served as locating and construction engineer with the Northern Pacific R.R., the Oregon Ry. & Navigation Co., the Farehaven & Southern R.R. and the Western Pacific R.R. During 1894, on reconnaissance for the Washington State Highway Commission and also served in an engineering capacity with the Portland (Ore.) City Water Works.

DR. FRANK W. GUNSAULUS, president of Armour Institute of Technology since its foundation more than 20 years ago, died suddenly March 17 in Chicago at the age of 65. He was considered one of Chicago's most noted clergymen, lecturers and educators.

BUSINESS NOTES

THE MERIWETHER PRESSURE PIPE CO. has been incorporated by Coleman Meriwether and associates with offices in the Board of Trade Building, Louisville, Ky., to manufacture reinforced concrete water pipe.

THE ERIE BALL ENGINE CO., Pittsburgh, Pa., has taken over the manufacture of Erie Ball engines, formerly made by the Ball Engine Co., Erie, Pa.

THE CONTRACTORS AND DEALERS EXCHANGE, New Orleans, at its annual meeting held Dec. 13, elected the following officers for the ensuing year: President, Robley S. Syearnes; vice-president, J. A. Hasse, Jr.; treasurer, W. W. Carre; secretary, H. W. Bond.

R. B. MURDOCK has resigned as executive engineer of the Asphalt Association and represents the F. D. Cummer & Son Co., manufacturer of asphalt paving plants and dryers, of Cleveland and New York. Mr. Murdock has offices at New York.

DRIFTING SAND FILTERS, LTD., with head offices in the Harbor Commission Building, Toronto, Ont., has been incorporated at Ottawa, Ont., to take over the Canadian patent rights of the John VerMehr Engineering Co. of Toronto and to promote drifting-sand filters such as were built a few years ago to treat a large part of the water supply of Toronto, and are in use in a few other places in Canada and elsewhere. The officials of the company include: President, E. L. Cousins, general manager Toronto Harbor Commission; general manager, Charles J. Townsend of the Russell-Townsend Co., contractors; consulting engineers, Gore, Nasmith & Storrie.

THE AUSTIN MACHINERY CORP. of Louisiana, Inc., announces its incorporation as sole distributor for Louisiana, Arkansas, Mississippi and Tennessee of the products of the Austin Machinery Corp., manufacturers of contractors' equipment.

THE T. L. SMITH CO., whose general sales offices have been located at Old Colony Bldg., Chicago, have moved their entire department and its personnel to Milwaukee, Wis., at the factories, 1125 32nd St.

Calder Committee Reports on Reconstruction

Puts Trust in Future in Governmental Investigations, Tax Revision and Bank-Loan Reform

Last year the United States Senate authorized the appointment of a committee "to inquire into the general building situation and to report such measures as may be deemed necessary to stimulate and foster the development of construction work in all its forms." This committee, composed of Senator Calder, chairman, and Senators Edge and Kenyon, had many hearings throughout the country. Its final report has just been made public.

The committee premises its report with a statement of the great depression in all construction, but devotes statistical attention only to the shortage in houses. Here it recognizes the untrustworthy character of the figures on building construction, but concludes that at the present rate of construction the country will be 2,000,000 "habitations" short in 1926. It records the primary causes of the shortage as governmental intervention due to the war, the rise in price in coal and transportation, the diversion of credit and the rigors of taxation. As secondary factors it lists labor and material costs, though the latter is manifestly a result of the stated primary causes. In the discussion of these features it devotes considerable space to statistical data on price and wage fluctuations.

The solution of the difficulties, according to the committee, lie in certain federal legislation which may be outlined as follows:

(1) A bill to establish in the Department of Commerce a division for the gathering and dissemination of information as to the best construction practices and methods, technical and cost data, and matters relating to city planning, etc., in order to encourage standardization and improved building practices throughout the country.

(2) A bill to provide for the gathering and publication by existing governmental agencies of current facts as to production, distribution, available supplies, standards of quality, costs and realization of coal.

(3) An amendment to the transportation act directing the Interstate Commerce Commission not to declare without hearings an emergency which will give preference of priority in transportation.

(4) An amendment to the Federal Reserve act to permit the Federal Reserve Board to direct the use of savings and time deposits of national banks for long-time loans, thus giving such deposits greater security and supplying a source of long-term money for home building.

(5) A home loan bank bill to provide for district home loan banks which may sell, under federal supervision, bonds secured by the aggregated loans deposited by the member banks.

(6) An amendment, limited to five years, to the revenue act of 1918, to provide for the exemption from excess profits and income taxes of the profits on the sales of dwelling houses where such profits, plus an equal amount, are reinvested in dwelling house construction.

(7) An amendment to the revenue act of 1918 to exempt from taxation interest on loans up to $40,000 on improved real estate used for dwelling purposes, when such loans are held by an individual.

(8) An amendment to the revenue act of 1918 limiting the taxation of profits from the sale of capital assets by providing for their taxation as of the years of accrual rather than as of the year of their sale.

(9) An amendment to the revenue act of 1918 to limit the surtax upon saved income to an amount not in excess of 20 per cent of such income.

(10) An amendment to the postal savings law increasing the limitation on deposits as to amount and time and authorizing the rate of interest to be changed from time to time and providing for compensation of postmasters for the extra duties.

The report recognizes the present system of taxation as an important factor but takes a firm stand against national, state or local governments attempting to relieve the housing situation by the granting of subsidies or by the erection of structures at governmental expense.

Priority orders, the report declares, have delayed the carriage of structural material and through delay rendered more hazardous and expensive building construction. As a means of decreasing or abolishing priority orders the committee suggests the amendment whereby the Interstate Commerce Commission may not declare, without hearing, an emergency which would give preference or priority to shipments.

Building Investigation Authorized by New Jersey Law

Authority for the Governor to appoint a commission for the investigation of alleged illegal combines operating to restrict building operation is aimed at in a bill recently passed by the New Jersey House of Assembly. The authority is contained in what is known as the Taylor resolution.

St. Paul Labor Bodies Plan to Enter Contracting

Through the incorporation of the "Central Board of Trade," the St. Paul (Minn.) Trades and Labor Assembly plans to enter the contracting business. Articles of incorporation will include two subsidiary organizations: one to direct construction and the other to purchase materials. The new organization expects to be able to bid sucessfully on several municipal contracts to be let this summer, according to press dispatches.

Construction Probe in Illinois

The Illinois State Legislature has appointed a committee of seven Senators and seven Representatives, headed by Senator John M. Dailey, to investigate alleged secret agreement price "rings" and "hold up labor tactics" in the building construction industry in Cook County. It has long been claimed that so-called labor agreements exist which effectually shut out all building materials not produced by members of the "ring" and that various abuses have been practiced rivaling or exceeding these disclosed by the Lockwood Committee in New York. Sittings of the committee began Friday, March 25.

It is planned for the work to proceed in co-operation with the States Attorney's office, the Chicago Police Department and the United States Department of Justice, that criminal proceedings may be taken at once should anything actionable be disclosed. The committee is armed with full authority to subpœna witnesses and compel the production of any records and papers it may wish to examine. Regardless of the ultimate findings of the investigation, it is intended to either give the industry a clean bill or eradicate any abuses, and thereby encourage prospective builders who may now be holding back because of reported wrongful practices in effect in the construction field.

Tug Strike in New York Called Off at Federal Request

At the solicitation of the United States Department of Labor the strike of the tugboat workers in the coastwise and Sound trade at New York City, a strike which was called by the unions of masters, mates, pilots and engineers as the result of a wage cut put into effect by the United Coast Tow Boat Association, was called off on March 25 by the union leaders. A committee on conciliation has been assigned by the Department of Labor to inquire into the differences between the association and the tugboat workers.

To Put New York Barge Canal on Businesslike Basis

A newly organized association entitled "Great Lakes-Hudson and Atlantic Waterways Association, Inc.," with offices at the National Marine League, 268 Pearl St., New York City, intends to educate the shipping public in the State of New York to the use of the New York State Barge Canal as a freight carrier. The association is made up of men interested in maritime and canal affairs in the state and has in it a number of the representatives of a number of the companies which operate barges on the canal. A committee is devising ways and means whereby barge lines can maintain regular schedules, issue through bills of lading to foreign ports from inland cities, adopt uniform rates, prepare official classifications of freight, and give shippers guarantees of good faith.

Canvass of Highway Bond Issues

State and county highway bond issues authorized between Jan. 1, 1919, and Dec. 31, 1920, including Illinois and Pennsylvania State bond issues voted in 1918, total $998,953,140, according to the results of a recent survey by the Portland Cement Association. Of the total amount, bonds in the sum of $594,132,072 were authorized prior to Dec. 31, 1919, and the remainder, $404,821,068 were authorized in 1920. Of all the states listed Minnesota leads with a total of $117,000,000 worth of bonds. Texas comes second with about $98,000,000, and Pennsylvania third with $81,000,000.

Jersey Shafts of Vehicle Tubes Held Up

The New York-New Jersey Tunnel Commissions have rescinded their call for bids for the Jersey ventilating shafts of the Hudson River vehicular tunnel, which were to have been opened March 29.

Builders Announce Wage Cuts in Many Localities

Wage cuts in the building trades, to become effective this spring, are being announced in many localities. The Building Trades Employers Association of Essex County, N. J., has announced a reduction averaging 10 to 20 per cent to take effect May 1, but wages of carpenters, painters, and decorators are to remain the same. Bricklayers, masons, plasterers, sheet metal workers, steamfitters' helpers, plumbers, metal lathers, wood lathers, mill workers, hod carriers and mason laborers will be subject to wage reductions, according to announcement of the association.

The general labor committee of the Associated Building Contractors of Indiana has proposed wage reductions in the building trades of 15 to 20 per cent. At Toledo, Ohio, the Contractors Association has outlined possible reductions of wages in the building trades of 35 per cent.

A statement issued by the Building Trades Employers Association of Worcester, Mass., last week indicates that the association intends to substantiate its original decision for a 20 per cent decrease in wages. At Rochester, N. Y., negotiations have been entered into between contractors and representatives of the building trades unions for a reduction of 15 per cent in wages.

The Master Builders Association at Denver, Col., has filed a notice of wage reductions averaging about 20 per cent. It is reported from Sacramento, Cal., that the Master Builders Association has undertaken to remove union restrictions and effect wage reductions.

At Harrisburg, Pa., the Building Trades Council [labor organization] has adopted resolutions demanding an increase in wages for plumbers, plumbers' helpers, carpenters and structural iron workers to take effect May 1.

Southern Pine Association Meeting in New Orleans

Announcement has been made that the sixth annual meeting of the Southern Pine Association will be held at the Grunewald Hotel, New Orleans, La., April 5-6. In addition to the usual trade subjects, the program will contain some matters of general industrial interest such as a paper entitled "Engineering Problems Affecting the Use of Southern Pine" by George E. Strehan, "The Architects Small House Service Bureau" by E. H. Brown, and "The Freight Rate Situation" by A. G. T. Moore. Considerable attention will be paid to the matter of governmental interference in business and the legality of the trade association.

California Bridge Contract Lower Than Estimate

Bids opened March 22 by the California State Highway Commission on the Feather River bridge showed a low bid of $157,647, which is about $92,000 less than the commission's estimate, $259,700, made about eight months ago. There were a great number of bidders on the job. Rumors were abroad at the letting that a number of the bidders put in figures only slightly above the actual net cost of the work at present prices. It is thought in California that the labor situation is clearing up. There is a very decided tendency toward lower wages, and an abundance of labor is in sight.

National Board Allocates Metal Sash and Door Work

Decisions allocating metal sash and door work between individual unions have been made by the National Board for Jurisdictional Awards as follows:

In the matter of the controversy between the International Association of Bridge and Structural Iron Workers and the Amalgamated Sheet Metal Workers' International Alliance relative to Hollow Metal Doors and Trim it is decided that the erection of hollow metal doors, made entirely of ten gage metal or lighter, except for local reinforcement, and the installation of the door frames and trim in direct connection with such doors is the work of the Sheet Metal Workers; except that in the case of sliding doors, street entrance and vestibule doors, elevator, shipping room and freight doors, and doors used exclusively for fire purposes the work is that of the Iron Workers. Kalamein or other wood-core doors are not covered by this decision.

The erection of metal partitions of ten gage metal or lighter, unless the structural framing of such partitions consists of rolled shapes or drawn tubing, is the work of the Sheet Metal Workers. In other cases it is the work of the Iron Workers.

In the matter of the controversy between the Amalgamated Sheet Metal Workers' International Alliance and International Association of Bridge and Structural Iron Workers over Hollow Sheet Metal Window Frames and Sash it is decided that the setting of hollow metal window frames and the hanging of hollow metal sash, when such frames and sash are made of No. 10 gage metal or lighter, is the work of the Sheet Metal Workers. The Campbell window and sash not being of hollow metal, its erection is awarded to the Iron Workers.

In the matter of the controversy between the Amalgamated Sheet Metal Workers' International Alliance, United Brotherhood of Carpenters and Joiners and International Association of Bridge and Structural Iron Workers relative to the setting of school seats it is decided that the work in question be awarded to the Carpenters.

Conditions in the Northwest Lumber Industry

A wage reduction of 12½ per cent in all building trades in Oregon and Washington, to take effect beginning May 1, was agreed upon at a meeting early in March in Spokane attended by representatives of the Contractors' Association and the Master Builders' Association. This action is reported to have the approval of labor organizations in both Oregon and Washington. The Loyal Legion of Loggers and Lumbermen has also agreed to reduce the daily wage basis to $3.60 per 8 hours. These wage reductions are expected to increase the demands for lumber and to improve the situation in the lumber industry generally. Cedar lumber is being sold in the Northwest for $9.00 to $10.00 per thousand, which is said to be only one-third to one-quarter the cost of production. Many lumber mills are shut down. The West Coast Lumbermen's Association is now advertising the fact that 60 per cent of the wages in Oregon and Washington are paid by the lumber industry and that that industry is in the advantageous position of having already "taken its deflation to pre-war level."

When the lumber mills reopen and the industry resumes its normal tone, a brisk demand for equipment and machinery used is expected because of the many replacements which will be required. Boilers are mentioned particularly as an item in which there has been much trading in second-hand and inferior equipment that will require renewal. Only a very small percentage of the mills have thus far been equipped with hogs for working up the mill scrap, and there will be the usual demand for donkey engines, hoists, cable and rigging of all sorts.

On the whole, and despite the present period of comparative inactivity, it is notable that reports from the Northwest contain many notes of optimism and refer to a considerable number of inquiries and prospective industrial development.

Wage Cut Agreement Averts Packing Industry Strike

The strike in the packing industry, threatened by refusal of the unions to accept wage reductions proposed by the packers, has been averted by an agreement made in Washington March 28 through the mediation of Secretaries Hoover, Wallace and Davis. The agreement, issued in the form of letters from both sides addressed to Secretary Davis, provides wage cuts of 8 cents per hour and for piece work scales a cut of 12½ per cent. The eight-hour day is held to be the basic working period. The agreement is binding until Sept. 15, 1921, holding in effect the agreement of Dec. 25, 1917, except as now modified, in the meantime binding both sides to arbitration decisions of Judge Samuel Alschaler.

Following the agreement, Redmond S. Brennan, a representative of the em-

ployees, praised the efforts of the three cabinet members in bringing about conciliation. "In the past," said Mr. Brennan, "I have never considered Herbert Hoover friendly toward labor, but I was gratified at the way in which he grasped the justice of our claims. He showed a remarkable knowledge of industrial principles and an accurate acquaintance with economic conditions."

It is thought in some quarters that the agreement will be only temporary, and that either side may take advantage of the Sept. 1 time limit to push its claims further.

New Track Anchors

To prevent creeping of rails and ties a device is being introduced which consists of a flat steel bar long enough to extend over six or eight ties and having holes for spikes. The bar is placed outside the rails, with its front portion, in the direction of creeping, spiked to the two joint ties and the remainder spiked to the next ties behind the joint. Thus the six or eight ties are connected to form one unit. Tie spacers may be used also, the spacer being a ⅜-in. square bar bent to form a channel 20 x 3½ in. The ends of the 3½-in. legs are chisel pointed, to be driven into two adjacent ties. These devices are being introduced by the Track Specialties Co., New York.

Holding Companies May Be Barred From Louisiana

An ordinance has been introduced in the state constitutional convention in Louisiana which provides that corporations whose main business is to own stock in other corporations are prohibited from incorporating and doing business in the State of Louisiana and are declared to be illegal.

Weekly Construction Market

THIS limited price list is published weekly for the purpose of giving current prices on the principal construction materials, and of noting important price changes on the less important materials. Moreover, only the chief cities are quoted.

The first issue of each month carries complete quotations for all construction materials and for the important cities. The last complete list will be found in the issue of March 3; the next, on April 7.

	New York	Atlanta	Dallas	Chicago	Minneapolis	Denver	San Francisco	Seattle	Montreal
Steel Products:									
Structural shapes, 100 lb	$3.58	$4.25	$3.75	$3.58	$3.86	$5.90	$4.70	$5.00	$5.00
Structural rivets, 100 lb	5.08	.....	7.05	5.08	5.50	6.90	7.05	6.25	8.50
Reinforcing bars, ¾ in. and larger, 100 lb	3.48	3.75	3.85	3.48	3.88½	4.37½	3.00	4.50	4.25
Steel pipe, black, 2½ to 6 in. lap, discount	39%	45.65–5%	40@45%	53½%	46.9–5%	29@33%	36¾@42½%	40%	5%
Cast iron pipe, 6 in. and over, 100 ton	63.30	64.00	66.20	64.10	67.80	70.00	87.65	75.00	80.00
Concreting Material:									
Cement without bags, bbl	3.10 (del.)	3.00	2.85	2.17	2.60	3.10	3.09	3.10	3.44
Gravel, ¾ in., cu.yd	2.50	2.62½	1.75	2.75	2.00	2.50	2.50	1.50	1.50
Sand, cu.yd	1.25	1.52½	1.75	2.75	.75	1.10	1.65	1.50	1.50
Crushed stone, ¾ in., cu.yd	2.15	2.50	3.20	2.75	2.25	3.50	2.50	3.50	2.10
Miscellaneous:									
Pine, 3x12 to 12x12, 20 ft. and under, M.ft	48.00	35.00	45.00	53.00	41.00	47.00	27.00	35.00	120.00
Lime, finished, hydrated, ton	21.00	18.00	25.00	20.00	29.00	32.00	25.40	27.00	30.00
Lime common, lump, 200 lb. bbl	3.30	2.00	2.50	1.65	2.00	3.20	2.25	3.25	16.00
Common brick, delivered, 1,000	21.70	12.00	25.00	15.00	18.00	16.00	18.00	19.00	18.00
Hollow building tile, 4x12x12, block	Not used	0.14	0.21	.12	.06	.11	.12½	.13	.25
Hollow partition tile 4x12x12, block	....	.15	.19½	.108	.....	.11	.14½	.11	.....
Linseed oil, raw, 5 bbl. lots, gal	.73	.74	.88	.82	.78	.95	.79	.79	.98
Common labor, union, hour	.75@.80	.35	.60@1.00	1.00	.50	.50@.63½	.81½	.75	.....
Common labor, non union, hour	.....	.25	.40@.60	.50	.50	.37½@.50	.50@.55	.50	.30@.40

Explanation of Prices—Prices are to contractors in carload lots unless other quantities are specified. For steel pipe, the prevailing discount from list price is given; 45-5% means a discount of 45 *and* 5 per cent, 45@50 means a range of 45 *to* 50 per cent. **New York** quotations are at warehouse, except cement and brick, which are delivered, and tile, which are "on trucks." Sand, gravel and crushed stone are quoted alongside dock. **Chicago** quotes hydrated lime in 50-lb. paper bags. **Minneapolis** quotes on fir instead of pine. Brick is $18 delivered, $16 on cars. Gravel, sand and crushed stone quoted at pit. Common labor not organized. **Denver** quotes cement "on tracks"; gravel and sand at pit, stone on cars, lime, brick and lumber on job. Tile price is at warehouse. Linseed oil, delivered. **Atlanta** quotes sand, stone and gravel per ton instead of per cu.yd. **Dallas** quotes lime by the 180-lb. bbl. **San Francisco** quotes on Heath tile, 5½ x 8 x 11½. Prices are all f.o.b. warehouses, except C. I. pipe, which is mill price, plus freight to railway depot at any terminal. Lumber prices are delivered "at ship tackle in San Francisco ex mill." **Montreal** quotes sand, stone and gravel per ton, and lump lime by the ton. No organized common labor in Montreal.

Changes Since Last Week

While the net price of cement delivered in New York remains $3.10, the charge for bags has been reduced from $1 per bbl. to 40c. The full line of steel prices at warehouse is expected to change this week, the new schedule to be announced in *Engineering News-Record* of Apr. 7.

While, at present, the New Orleans market is not quoted weekly, reports show decreases in the prices of pine lumber, cement, brick, sand, gravel and wood blocks. Rough boards are down $10, the present level being $55 per M. ft. b.m.; 2-in. tongue-and-grooved is down $5; 8 x 8s down $3; 12 x 12s down $4. Small demand has caused this decrease, and a better market is not expected until July, according to a large dealer. Gravel is down 15c., to $2.85; sand down 10c., to $1.65; common brick down $2.50, to $21.50 per 1,000; cement down 24c., to $3.36, net. This general decline is attributed to "reduced costs." Wood blocks are off sharply: 3-in. now sells for $1.88 per sq.yd., against $2.99 a month ago; 3½-in., $2.24, against $3.42; 4-in., $2.56, against $3.85. The explanation is the reduced costs of lumber, creosote oil and labor.

Labor Conditions

San Francisco reports labor of all classes plentiful and a feeling in business circles that general conditions will soon improve. Unemployment in Denver has been reduced 10 per cent in the building trades; wage reductions generally accepted, except by bricklayers and carpenters, who threaten to strike on Apr. 1. A greatly reduced scale is expected to be announced in Montreal on Apr. 1. In New Orleans the present scale will be maintained until June. The controversy between the Metal Employers' Association and the metal Workers' Union was not decided on Mar. 15, as was expected, but was postponed until Apr. 1. The points at issue are: 48-hour week, instead of present 44-hour; 10 per cent wage reduction; elimination of double shift with extra pay. The workers have practically agreed to the first two conditions, but are contesting the third. No changes in construction-labor rates.